STAR

MAY 8, 1969

VOLUME 7 • NUMBER 9

N69-19601—N69-20700

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Scientific and Technical Aerospace Reports, Volume 7, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by the Technical Information Services Company.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

Introduction

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02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **1450**

03 AUXILIARY SYSTEMS
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05 BIOTECHNOLOGY
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06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **1467**

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Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **1478**

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Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **1491**

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11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **1496**

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Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **1501**

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Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **1508**

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Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **1536**

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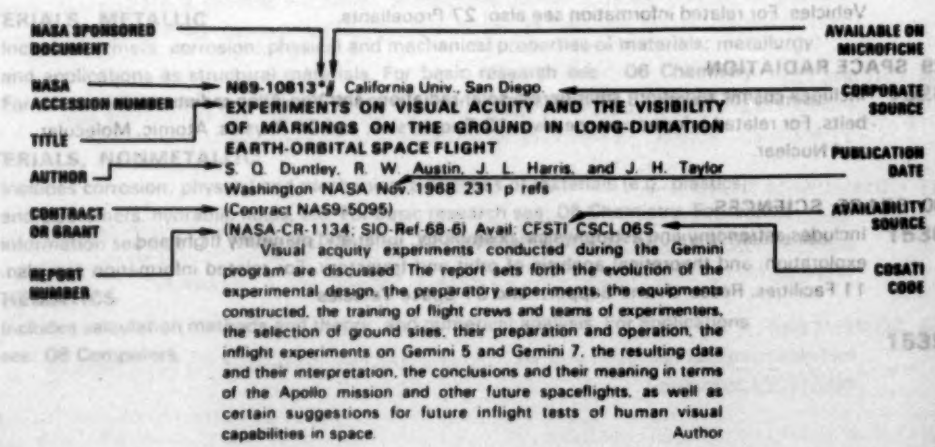
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AUTHOR
S. Q. Duntley, R. W. Austin, J. L. Harris, and J. H. Taylor
PUBLICATION DATE
Washington NASA Nov. 1968 231 p refs
CONTRACT OR GRANT
(Contract NAS9-5095)
AVAILABILITY SOURCE
(NASA-CR-1134; SIO-Ref-68-6) Avail: CFSTI CSCL 06S
REPORT NUMBER
COSATI CODE
Visual acuity experiments conducted during the Gemini program are discussed. The report sets forth the evolution of the experimental design, the preparatory experiments, the equipments constructed, the training of flight crews and teams of experimenters, the selection of ground sites, their preparation and operation, the inflight experiments on Gemini 5 and Gemini 7, the resulting data and their interpretation, the conclusions and their meaning in terms of the Apollo mission and other future spaceflights, as well as certain suggestions for future inflight tests of human visual capabilities in space.
Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery, wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N69-19621*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THE LEADING EDGE EFFECTS ON A LAMINAR FLAT-PLATE BOUNDARY LAYER AT MACH 10.4

Howard W. Stone (M.S. Thesis—Va. Univ.) May 1968 114 p refs

(NASA-TM-X-61523) Avail: CFSTI CSCL 20D

An experimental investigation was performed at Mach 10.4 in air on a 30 inch flat plate model with cylinderical leading edges of 0.002 inches, 0.063 inches, and 0.50 inches in diameter to examine the leading edge thickness effect on the laminar boundary layer. The free stream Reynolds number based on leading edge diameter was varied between 73 and 70,000. Wall pressure distributions, boundary layer impact pressure surveys, and wall heat transfer distributions were measured and velocity profiles, boundary layer growth, skin friction, and Reynolds analogy factor were determined. The wall pressure distributions are compared with a viscous interaction theory and the modified blast wave theory. The boundary layer profiles, skin friction, and heat transfer are compared with a zero-pressure gradiant laminar boundary layer theory and a boundary layer growth correlation is shown. Author

N69-19641*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A NUMERICAL METHOD FOR EVALUATION AND UTILIZATION OF SUPERSONIC NACELLE-WING INTERFERENCE

Robert J. Mack Washington Mar. 1969 27 p refs

(NASA-TN-D-5057) Avail: CFSTI CSCL 01A

A numerical method for calculating (1) the inviscid flow nacelle-wing interference loads on a warped wing surface, (2) a load-compensating reflex camber surface for optimization purposes, and (3) the interference-lift effective-area contribution to sonic-boom pressure disturbances are presented and discussed. Within the limitations of a modified supersonic linearized theory, the numerical method can provide reasonable good estimations of the loads imposed on a wing surface by nacelles mounted nearby. Author

N69-19644*# Bellcomm, Inc., Washington, D. C.

AERODYNAMIC TORQUE ON A SPACE VEHICLE

E. Y. Yu 12 Dec. 1968 32 p refs

(Contract NASw-417)

(NASA-CR-100319; TM-68-1022-10) Avail: CFSTI CSCL 20D

An analytical expression is obtained for the aerodynamic torque, which a space vehicle, configured as a finite cylinder and two flat solar panels, encounters while passing through rarefied air at a high altitude. The torque is evaluated seperately on each component unit, taking into consideration the front, back, and end surfaces and the general direction of the air velocity with respect to the vehicle. The overall torque is given as the sum of the torques on the component units. The analytical expression of the torque may be used to investigate the equilibrium and stability of the attitude motion of the vehicle. Also, for a given attitude orientation of the vehicle, the torque may be integrated around an orbit to give the magnitude of angular momentum that an active attitude control system will have to counteract. Author

N69-19695*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A NEW WIND-TUNNEL TECHNIQUE FOR THE MEASUREMENT OF VARIOUS AIRCRAFT STABILITY DERIVATIONS

Irving Abel (M.S. Thesis—Va. Polytech. Inst.) Jun. 1968 130 p refs

(NASA-TM-X-61518) Avail: CFSTI CSCL 20D

A new wind-tunnel technique for measuring various aerodynamic derivatives of an aeroelastic model is presented. The technique applied free-flight procedures to a model flown in the wind tunnel on the two-cable-mount system. In the case of longitudinal motion, it is theoretically possible to uniquely determine each of the aerodynamic derivatives by measuring the model response to a steady-state sinusoidal oscillation of the horizontal tail. A comparison between free-flight and wind-tunnel equations shows that, due to the added mount system restraints, the equations can be solved for each derivative uniquely. In the lateral equations of motion, a basic free-flight assumption of single-degree-of-freedom response in roll allows the experimental verification of the dynamic approach to derivative measurements. Experimental results obtained on an aeroelastically scaled model, tested both statically and dynamically in the wind tunnel, verify the application of this new testing procedure. Author

N69-19722# Aeronautical Research Council (Gt. Brit.)

MEASUREMENTS OF THE EFFECTS OF THICKNESS ON VORTEX BREAKDOWN POSITION ON A SERIES OF SHARP-EDGED DELTA WINGS

P. B. Earnshaw Feb. 1968 14 p refs Supersedes RAE-TR-68050; ARC-30405

(ARC-CP-1018; RAE-TR-68050; ARC-30405) Copyright Avail: CFSTI; HMSO 3s 6d

Measurements have been made of vortex breakdown position on a series of symmetrical delta wings of 70° sweep angle but differing thickness distribution using a schlieren system to detect the breakdown. The results demonstrate that the angles of incidence necessary to achieve a given position of breakdown over the wing

can differ by at least as much as 5° from a thin wing to a wing of 8% thickness-chord ratio. The tests also show the breakdown position to have a weak dependence on Reynolds number.
Author (ESRO)

N69-19725# Aeronautical Research Council (Gt. Brit.)
THE PERFORMANCE OF AN AEROFOIL IN STATIONARY AND ROTATING CASCADES
E. C. Deverson, H. Marsh, and J. T. B. Oxford 1968 53 p refs Sponsored by Sci. Res. Council and Min. of Technol. Supersedes ARC-29175
(ARC-CP-1022; ARC-29175) Copyright. Avail: CFSTI; HMSO 9s 6d

A series of experiments have been performed with a rotating cascade wind tunnel to determine the effect of a rotational flow on the behavior of the blades in a turbomachine. A two-bladed rotor has been tested as a stationary annular cascade and also when rotating synchronously with a solid body rotational flow. It is then possible to make a direct comparison between the behavior of the same blade in irrotational and rotational flows. It is shown that if the level of turbulence is greater than some critical value, then there is no significant difference in the unstalled performance of the blades in the stationary and rotating cascades. However, even at a relatively high level of turbulence, there is a marked difference in the manner in which the blade stalls for the stationary and rotating cascades.
Author (ESRO)

N69-19756# National Physical Lab., Teddington (England). Aerodynamics Div.
THE CORRELATION AND PREDICTION OF PRESSURE DISTRIBUTIONS ON COMPRESSION SURFACES OF SHARP-EDGED CONICAL BODIES AT HIGH SUPERSONIC SPEEDS
M. J. Larcombe May 1968 13 p refs
(NPL-AERO-1261; ARC-30287) Avail: CFSTI

A method for calculating the pressure distributions around conical bodies at high supersonic speeds, based on a local cone-flow theory, has been developed from the successful correlation of pressures at a symmetrical ridge line. The method is shown to provide a means for the accurate estimation of pressures on compression surfaces of conical bodies with sharp leading edges, providing the shock wave is detached from the edge.
Author (ESRO)

N69-19761# National Physical Lab., Teddington (England). Aerodynamics Div.
THE OSCILLATIONS OF MODEL CIRCULAR STACKS DUE TO VORTEX SHEDDING AT REYNOLDS NUMBERS FROM 10^5 TO 3.10^6
L. R. Wootton Jun. 1968 66 p refs
(NPL-AERO-1267) Avail: CFSTI

The results of an experiment on the response of model stacks free to oscillate under the influence of aerodynamic forces in a Compressed Air Tunnel are presented. Reynolds number had a considerable influence on the response in both subcritical smooth flow. For both models with polished and with slightly roughened surfaces, large peak amplitudes of oscillation found at subcritical Reynolds numbers decreased as the critical regime was approached. For the models with roughened surfaces, further increases of Reynolds number produced continuously higher peak amplitudes and the reduced velocity giving the peak amplitudes decreased from approximately 6.5 to 5. For the polished models no such similar peaks were found in the supercritical regime up to $R = 2.10^6$, the maximum available, but peak amplitudes occurred at reduced velocities of 10 and 13. For all Reynolds numbers, the amplitude of oscillation had a considerable effect on the characteristics of the vortex shedding forces on the stacks.
Author (ESRO)

N69-19762# Aeronautical Research Council (Gt. Brit.)
SOME COMMENTS ON THE CONDITIONS IN A LOCAL SUPERSONIC FLOW REGION
T. H. Moulden 1968 33 p refs Supersedes NPL-AERO-1169-REV; ARC-27322-REV
(ARC-CP-1023; NPL-AERO-1169-Rev; ARC-27322-Rev) Copyright. Avail: CFSTI; HMSO 6s

The paper sets out to summarize the properties of the flow in a local supersonic, two-dimensional, steady potential flow region. Starting from the results of the theory of characteristics, the concept of wave strength is introduced and used to develop logically the properties of the supersonic region. The conditions which must be imposed on the flow in order that it shall remain irrotational are reviewed. The practical significance of this is mentioned.
Author (ESRO)

N69-19784# Aeronautical Research Council (Gt. Brit.)
THE LONGITUDINAL CHARACTERISTICS OF THREE SLENDER 'MILD OGEE' WINGS AT MACH NUMBERS FROM 0.4 TO 2.0
D. G. Mabey and G. P. Ilott 1968 69 p refs Supersedes RAE-TR-67202; ARC-106
(ARC-CP-1006) Copyright. Avail: CFSTI; HMSO 15s 6d

Wind tunnel measurements of lift, pitching moment and drag on one plane and two cambered wings of 'mild ogee' planform ($p = 8/15$) are reported. These measurements are supplemented by vapour screen and oil flow observations. The wings were designed by slender wing theory for attached flow along the leading-edge at particular values of lift and pitching moment. The design and measured attachment conditions agreed fairly well. The non-linear lift developed could be related with the type of vortex development above the attachment incidence.
Author (ESRO)

N69-19826*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL PRESSURE DISTRIBUTIONS ON A 120° CONE AT MACH NUMBERS FROM 2.96 TO 4.63 AND ANGLES OF ATTACK FROM 0° TO 20°
Robert L. Stallings, Jr. and Dorothy H. Tudor Washington Mar. 1969 77 p refs
(NASA-TN-D-5054) Avail: CFSTI CSCL 01A

A sharp and a blunt 120° cone configuration were tested. The blunt configuration consisted of a spherical segment with a radius of 1/8 the base diameter and which faired into a 120° cone frustum. The tests were conducted at Mach 2.96, 3.95, and 4.63 over a range of angles of attack from 0° to 20°. Pressure distributions and shock shapes obtained on both the sharp and blunt cones at an angle of attack (α) of 0° were in good agreement with an approximate theoretical solution based on the one-strip method of integral relations. Mach number had no effect on pressure distributions expressed in the form of local measured pressures divided by the free-stream pitot pressure ($p_l/p_{t,2}$) for either the sharp or blunt configurations at $\alpha = 0°$. At $\alpha > 0°$, the Mach number effect was confined to the leeward side of both configurations and consisted of a decrease in $p_l/p_{t,2}$ with increasing Mach number. Pressure distributions on the cone frustum of the blunt and sharp configurations were essentially the same throughout the range of test variables. An approximate technique involving a tangent-cone concept is presented for predicting the windward and leeward pressures for $\alpha > 0°$. Results from this method are in fair agreement with experimental results both in the form of pressure distributions and force coefficients. For $\alpha > 0°$, the local pressures around the circumference of both the sharp- and blunt-cone configurations, nondimensionalized by the pressure measured along the windward ray, were in good agreement with an empirically derived second-order polynomial.
Author

N69-19925*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A METHOD FOR DETERMINING THE TOTAL DRAG OF A POINTED BODY OF REVOLUTION IN SUPERSONIC FLOW WITH TURBULENT BOUNDARY LAYER

Charlie M. Jackson, Jr. and Rudeen S. Smith Washington Mar. 1969 67 p refs

(NASA-TN-D-5046) Avail: CFSTI CSCL 01A

An approximate mathematical model of the inviscid and viscid flow field about a body of revolution was developed by utilizing modifications of the second-order shock-expansion theory and of a theoretical analysis of compressible boundary layer growth with pressure gradient. The area of application of this model is intended to be restricted to the attached bow-shock condition in the supersonic flow region with an all turbulent boundary layer. The viscid–inviscid interaction is accounted for by iteration between the respective theories. The solution of the mathematical model including the iteration and the integration of surface conditions to give wave and friction drags was programmed for digital computation, and the program is included. The viscid and inviscid solutions including interactions were applied to several body shapes over a wide range of test conditions and the resulting total drag estimates generally agreed with the reported experimental values to within 5 percent. In view of the difficulty involved in obtaining precise experimental data, it is believed that the present method is generally as accurate as the current experimental testing techniques. Author

N69-19926*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF CONE ANGLE, BASE FLARE ANGLE, AND CORNER RADIUS ON MACH 3.0 AERODYNAMIC CHARACTERISTICS OF LARGE-ANGLE CONES

William D. Deveikis and James Wayne Sawyer Washington Mar. 1969 47 p refs

(NASA-TN-D-5048) Avail: CFSTI CSCL 01A

A wind tunnel investigation was conducted on large angle cones to determine the effects on static aerodynamic characteristics of cone angles from 110° to 150°, base flare angles from 65° to 90°, and base corner radii to 20 percent of the base radius. The tests were conducted at angles of attack to 12° and at Reynolds numbers, based on maximum body diameter, of approximately 1.1×10^6 and 3.0×10^6 in a Mach 3.0 stream. All models were statically stable, and aerodynamic centers were located downstream from the base. The static stability was relatively insensitive to cone angle but decreased as the flare angle and corner radius increased. The axial force coefficient increased with cone angle and flare angle but decreased with increasing corner radius. Author

N69-19934*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF AXIAL RUNNING CLEARANCE ON PERFORMANCE OF TWO BRAYTON CYCLE RADIAL INFLOW TURBINES

Samuel M. Futral, Jr. and William Nusbaum Feb. 1969 21 p refs

(NASA-TM-X-52552) Avail: CFSTI CSCL 10A

The effect of increasing the axial running clearance on the efficiency and mass flow rate was determined experimentally. The variation in clearance was accomplished by appropriate shimming of the scroll. The two radial inflow turbines involved had 5-inch (12.82-cm) and 6-inch (15.29-cm) rotor tip diameters. The results indicated little effect on efficiency with a 1 percent increase in clearance-to-height ratio yielding a 1/5 to 1/3 percent change in efficiency. The associated effect on mass flow rate was found to be slight. Author

N69-19965# National Physical Lab., Teddington (England). Aerodynamics Div.

COMPARISON OF THREE METHODS FOR THE EVALUATION OF SUBSONIC LIFTING-SURFACE THEORY

H. C. Garner, B. L. Hewitt (Brit. Aircraft Corp.) T. E. Labrujere (Natl. Aerospace Lab., Amsterdam) 17 Jun. 1968 52 p refs

(NPL-AERO-1272; ARC-30324) Avail: CFSTI

Independent numerical methods for obtaining the subsonic load distribution on a thin wing of arbitrary twist and camber have been developed at NPL, NLR (Netherlands) and BAC (Warton). The three methods have been studied jointly and their novel features have been reviewed critically. The best solutions by each method show excellent agreement for wings, at uniform incidence, having smooth leading and trailing edges. Spanwise loading, local aerodynamic centres, lift, pitching moment, vortex drag and chordwise loadings are tabulated for circular and rectangular planforms, for a wing of constant chord with hyperbolic leading and trailing edges, and for a tapered sweptback wing. The convergence of the solutions is examined in detail with respect to separate parameters representing the numbers of spanwise integration points and spanwise and chordwise collocation points. The tapered sweptback planform is considered with different amounts and types of artificial central rounding, but the crucial problem of a central kink under lifting conditions remains a subject for research. Author (ESRO)

N69-20016*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

WIND-TUNNEL DATA FROM A 0.18-SCALE V/STOL MODEL WITH DIRECT-LIFT AND LIFT-CRUISE JETS

Matthew M. Winston Washington Mar. 1969 72 p refs

(NASA-TM-X-1758) Avail: CFSTI CSCL 01C

Investigations were conducted on a 0.18-scale V/STOL model in the 17-foot (5.18-meter) test section of the Langley 300-mph 7- by 10-foot tunnel. Six cold-air ejectors were used to simulate four direct-lift and two lift-cruise jet engines. Longitudinal and lateral-directional aerodynamic characteristics were investigated for various model configurations, forward speeds, and power conditions in the transition and cruise flight ranges. In addition to control-effectiveness studies, the effects of power variations for different lift-nozzle settings and the effects of height above the ground were investigated. Author

N69-20147*# Techtran Corp., Glen Burnie, Md.

FREQUENCY METHOD OF MEASUREMENT: MEASUREMENT OF VELOCITY AND ACCELERATION AND OF ANGLE AND ANGULAR VELOCITY OF AN AERODYNAMIC BODY [CHASTOTNYY METOD IZMERENIYA, IZMERENIYE SKOROSTI I USKORENIYA, UGLA I UGLOVOY SKOROSTI TELA]

I. I. Pomykayev Washington NASA Mar. 1969 24 p Transl. into ENGLISH from Tr. Mosk. Aviats. Inst. Sb. Statei (Moscow), no. 179, 1968 p 58–77

(NASw-1695)

(NASA-TT-F-12159) Avail: CFSTI CSCL 01A

The application of the frequency method to measurement of the velocity, accelaration, angle and angular velocity of aerodynamic bodies is discussed. The basic equations of the method are derived. Expressions for determining the required frequency of a self-exciting oscillator, the code unit values involved, and the error of the method are also given. Threshold relations for certain laws of variations in the values being measured are derived. These relations are required for the formation of a code unit for pulses of a self-excited oscillator. Author

N69-20151# Western Ontario Univ., London. Boundary Layer Wind Tunnel Lab.
THE EFFECT OF TURBULENCE ON THE AEROELASTIC INSTABILITY OF A SQUARE PRISM
M. Novak Jul. 1968 29 p refs Supported by the NRC of Can.
(BLWT-7-68)Avail: CFSTI

Lateral oscillations of a square prism arising due to its aerodynamic instability (often called galloping oscillations) are experimentally studied in turbulent flow with a vertical profile of mean wind velocity. It appears that these vibrations exist even in a highly turbulent flow, being somewhat less intensive and more random in character than in a smooth flow. The possibility of a universal representation of galloping oscillations for bodies having different mass and damping, shown earlier in smooth flow, are experimentally extended to include turbulent flow. Such universal galloping response of square cantilevered prisms is derived. The results are presented in a graphical form and can be used to predict the aeroelastic instability of structures with a square cross-section in open country and urban areas. Author

N69-20171# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD FOR CALCULATION OF SUPERSONIC FLOW PAST BLUNT BODIES WITH A DETACHED SHOCK WAVE
S. M. Cilinskii, G. F. Telening, and G. P. Tinyakov Apr. 1968 46 p Transl. into ENGLISH from Sbornik Rabot, Moscow Univ., Vychislitelnyi Tsentr (Moscow), no. 6, 1967 p 173–205
(AD-680923; FTD-MT-24-33-68) Avail: CFSTI CSCL 20/4

The paper deals with the development of a method for calculating supersonic flow past blunt bodies with a detached shock wave. The first section contains a formulation of the problem of supersonic flow past a blunt body of an arbitrary shape and an investigation of basic gas-dynamics equations. A method is given for the selection of a differential system for solving a boundary problem. This is followed by sections on the construction of an algorithm for the numerical solution of a boundary value problem in a mixed region and on the method of solving a nonlinear problem. The final section gives examples illustrating the solution of different problems of flow past bodies of different shapes with a detached shock wave. Author (TAB)

N69-20238# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
EXPERIMENTAL STUDY ON THE DRAG OF BLUNT BODIES OF REVOLUTION AT HYPERSONIC SPEEDS
Motoki Hinada Dec. 1968 53 p refs *Its* Vol. 33, No. 14
(ISAS-432) Avail: CFSTI

Drag coefficients of blunt bodies and characteristics of shock wave ahead of them have been investigated in the range of Mach numbers from 8 to 12. Semi-conductor strain gauge balance was used for the drag force measurement within the flow duration of 90 to 500 msec. About fifty models of blunt bodies including cones, spherical-nose bodies and concavenose bodies have been tested. The drag coefficient of a circular disc at hypersonic speeds is taken as a reference body, and the drag coefficient relative to that of the disc has been obtained for each body. It is found that the drag coefficient of the cone with semi-apex angle between 45° and 70° is higher than that predicted by the Newtonian theory, and that the drag in this case is decreased by a proper blunting of the nose. This phenomenon is explained by a physical consideration concerning the flow characteristics over the cone surface. Shape and stand-off distance of the shock wave have been investigated by schlieren pictures. The stand-off distance for the sharp cone is found to be linear with its semi-apex angle, and agrees well with an approximate theory based on the constant steam-tube-area approximation of Hayes. Author

N69-20271 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
ANALOGUE CALCULATION OF AIRFOIL PROFILES IN THE TRANSONIC REGIME [DETERMINATION ANALOGIQUE DE PROFILS D'AILE EN REGIME TRANSSONIQUE]
F. Rigaut Sep. 1968 31 p refs In FRENCH
(B-855) Avail: CFSTI

An analogue calculation method is presented based upon the finite differences representation of the hodograph equations of transonic flow. After a brief review of both analogue and hybrid methods, special emphasis is given to the study of profiles. The cases of symmetrical profiles, zero lift profiles, and lifting profiles are treated in succession. Examples and comparisons are submitted which illustrate the possibilities of the method. Finally, a calculation algorithm is presented for determining, by means of a hybrid technique, a flow with a shock wave. The method is also applicable to the calculation of cascades, and several examples are submitted. Author

N69-20276# Aeronautical Research Council (Gt. Brit.)
TABLES OF SUPERSONIC SYMMETRICAL FLOW AROUND RIGHT CIRCULAR CONES, WITH AND WITHOUT THE ADDITION OF HEAT AT THE WAVE
R. S. Bartlett 1968 92 p refs Supersedes RAE-TR-66278; ARC-28725
(ARC-R/M-3521; RAE-TR-66278; ARC-28725) Copyright. Avail: CFSTI; HMSO £2

The generalised relations for shock, strong detonation and Chapman-Jouguet detonation waves are used to determine the flow variables behind an attached conical shock wave. The non-linear ordinary differential equations of conical flow and their integration, inwards from the wave, are discussed. In the case of the shock wave (adiabatic flow), tables of the flow are given over representative ranges of cone angle and mach number, for an ideal gas, with $\gamma = 1.4$. A few tables of the complete flow between wave and cone are given for the case of non-zero heat addition. The dependence of the wave angle and the transverse velocity component on a heat addition parameter, F, is also studied. It is found that the variation of wave angle, for given values of Mach number and cone angle, is such that an approximate collapse onto a single curve is possible. As a result, a good approximation to the value of the wave angle corresponding to any value of F may be obtained, within the ranges of Mach number and cone angle considered here. Author (ESRO)

N69-20359# Rutgers Univ., New Brunswick, N. J. Dept. of Mechanical and Aerospace Engineering.
AXISYMMETRIC TURBULENT NEAR-WAKE STUDIES AT MACH FOUR: BLUNT AND HEMISPHERICAL BASES Interim Report
W. R. Sieling, C. E. G. Przirembel, and R. H. Page Nov. 1968 121 p refs
(Contract F44620-68-C-0018)
(AD-681165; AFOSR-68-2465) Avail: CFSTI CSCL 20/4

The axisymmetric turbulent near-wakes of two base configurations (blunt and hemispherical) at Mach four were experimentally investigated. A special annular wind tunnel was used which completely eliminated any support interference effects. Detailed pressure measurements were made in all regions of the near-wakes as well as on the bodies. Several flow visualization techniques were used in conjunction with pressure measurements to locate the separation and rear stagnation points. Conventional and color schlieren techniques were used with still and high speed motion picture cameras to qualitatively determine the overall flow patterns. A comparison of the data for the two base geometries indicated a noticeable similarity between the two reattachment processes. Author (TAB)

N69-20435# Aeronautical Research Council (Gt. Brit.)
DIRECTIONAL STABILITY IN FLIGHT WITH BANK ANGLE CONSTRAINT AS A CONDITION DEFINING A MINIMUM ACCEPTABLE VALUE FOR n_v
W. J. G. Pinsker Jun. 1968 5 p refs Supersedes RAE-TR-67127; ARC-29470
(ARC-R/M-3556; RAE-TR-67127; ARC-29470) Copyright. Avail: CFSTI; HMSO 8s 6d

When bank angle is constrained by aileron control, the lateral motion degenerates into a simple directional oscillation, which becomes divergent when the 'effective' directional stability parameter (N_v-$n/1_v$) becomes negative. This condition is proposed as a criterion to define a minimum acceptable value for NXv. This condition has been observed on the BAC221 in flight at very low speed and the agreement is sufficient to support this theory. This criterion derived here has particular importance with modern high speed aircraft in which loss of N_v often does not lead to instability according to classical control fixed stability analysis. It is also suggested that the usable low speed range of such an aircraft can be substantially extended if aileron yaw is made proverse by, e.g. a control link between rudder and aileron. Author (ESRO)

N69-20456*# College of Aeronautics, Cranfield (England).
AQUAPLANING: THE BRITISH MINISTRY OF TECHNOLOGY PROGRAMME
J. R. Williams *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 81-99 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 01B

Research at the College of Aeronautics, Cranfield, using a Hawker Siddeley Hunter F.6 was concerned with discovering the minimum depth of standing water required to support an aquaplaning tire and to evaluate the effects of runway texture and tire pressure on this critical depth. The method used was to measure the height of the aquaplaning tire above the runway surface and the probe devised for this purpose is briefly discussed. Attempts have been made to obtain criteria for runway surface texture and to correlate these with the aquaplaning characteristics of the runway. The height of the aquaplaning tire above the runway surface is proposed as an important characteristic of the phenomenon which can be used as a measure of runway and tire performance. Measurements made have yielded some information on tire distortions during aquaplaning, which assists in the description and understanding of the phenomenon. Author

N69-20527# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRACTICAL AERODYNAMICS OF THE AN-24 AIRPLANE
L. E. Bogoslavskii May 1968 255 p refs Transl. into ENGLISH of the book "Prakticheskaya Aerodinamika Samoleta AN-24" Moscow, Transport, 1967 p 1-232
(AD-680996; FTD-HT-23-1522-67) Avail: CFSTI CSCL 1/3

The book presents the design and aerodynamic characteristics of the An-24 passenger airplane, discusses the subjects required for piloting techniques, and gives specific recommendations for flight operations. The book contains only that information from theory of flight which facilitates the study of the practical aerodynamics and flight operations questions which are considered. The text is written on the basis of the aerodynamic design of the An-24 airplane, performed in the OKB, and from practical experience in operating the airplane in the civil aviation flight sections. Author (TAB)

N69-20553# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany).
ON THE CALCULATION OF THE PRESSURE DISTRIBUTION IN INCOMPRESSIBLE FLOW AROUND AIRFOILS GIVEN BY AERODYNAMIC PARAMETERS [ZUR BERECHNUNG DER ANALYTISCHEN DRUCKVERTEILUNG BEI INKOMPRESSIBLER STROEMUNG UM TRAGFLUEGELPROFILE, WELCH DURCH AERODYNAMISCHE FORMPARAMETER GEGEBEN SIND]
W. Fischeder Dec. 1968 49 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-79) Avail: CFSTI

The airfoil geometry is given by a number of analytical functions which are constant over the depth of the airfoil. Six parameters of these functions are chosen which determine the aerodynamic characteristics of the flow. The profiles are assumed to have a finite nose radius. The singularity theory is used for the analytical determination of the pressure distribution around slightly cambered profiles in first and second approximation. The significant effect of the nose radius in dependence of the angle of attack on the flow near the profile nose is clearly demonstrated. Formulas for all necessary calculations are presented in 11 tables. Transl. by K.W.

N69-20577# Western Ontario Univ., London. Faculty of Engineering Science.
AEROELASTIC GALLOPING OF RIGID AND ELASTIC BODIES
Milos Novak Mar. 1968 84 p refs Supported by Nat'l. Res. Council of Can.
(BLWT-3-68) Avail: CFSTI

Galloping oscillations of long prismatic bodies with aerodynamically unstable cross-sections in the direction normal to that of the acting steady wind are analyzed. Principally, the steady vibrations are discussed under different conditions on the basis of the quasi-steady approach which leads to the nonlinear differential equation of self-excited oscillations. The first approximation of the Bogoliubov and Krylov method is used with one degree of freedom systems and energy considerations are applied with continuous systems. It is found that the steady amplitudes are determined by an algebraic equation which is formally identical for all systems both simple and with many degrees of freedom even in wind with variable mean speed along the structure. Formulas are given which enable the transition from a rigid section to an elastic continuous structure. Finally, it is proved that for all structures having a certain type of cross-section and the same modes of free vibrations but arbitrary mass and damping, the steady amplitudes are described by the solely universal response curve. Author

N69-20623# Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
A DIGITAL COMPUTER PROGRAMME FOR PREDICTING PRESSURE DISTRIBUTIONS ON SWEPT WINGS IN SUBSONIC FLOW ACCORDING TO A SEMI-EMPIRICAL METHOD
W. Loeve and A. L. Bleskrode Apr. 1967 35 p refs Submitted for publication Sponsored by Neth. Min. of Defense
(NLR-TR-T-143) Avail: CFSTI

A computer programme is presented for the application of a semi-empirical method, based on work from the Royal Aircraft Establishment, for calculation of the pressure distribution on wings in subsonic attached flow. A comparison of calculated results with results of experiments is made with the purpose to determine some of the boundaries of the region of applicability of the method. From the results presented, conclusions are drawn about the possibilities to increase the region of applicability of the method. Author (ESRO)

N69-20638# Aeronautical Research Council (Gt. Brit.)
GUIDED WEAPONS AERODYNAMIC STUDY. FORCE AND MOMENT MEASUREMENTS ON SOME MONOPLANE AND CRUCIFORM SLENDER WING-BODY COMBINATIONS AT M = 4.0
P. L. Roe 1968 26 p refs Supersedes RAE-TR-66342; ARC-28708
(ARC-CP-972; RAE-TR-66342; ARC-28708) Copyright. Avail: CFSTI; HMSO 5s 6d

Force and moment measurements are presented for a family of slender delta monoplane wings (aspect ratios 0.826, 0.517, 0.309, 0.229) in combination with a common ogive-cylinder body. Two of these (aspect ratios 0.826 and 0.309) are also studied in cruciform layout. Results are given for variations in incidence at zero roll, and variations in roll at constant pitch. Longitudinal characteristics are compared with an empirical prediction method, and with test results at lower Mach numbers. Author (ESRO)

N69-20640# Western Ontario Univ., London. Faculty of Engineering Science.
AN EXPERIMENTAL STUDY OF THE RESPONSE OF A SQUARE PRISM TO WIND LOAD
Peter Rosati (M.S. Thesis) Mar. 1968 114 p refs
(Grant NRC A-1233)
(BLWT-2-68) Avail: CFSTI

The dynamic response of a finite square prism to turbulent boundary layer flow was measured. The tests were conducted in a boundary layer wind tunnel which had a sufficiently long working section to develop a turbulent flow comparable with atmospheric. The model response was measured at different wind speeds and discrete variations were made in model density, damping, flow turbulence and angle of attack of the wind. The mean drag response was measured and found to be independent of the turbulence level. Author

N69-20668# Aeronautical Research Council (Gt. Brit.)
AERODYNAMIC CHARACTERISTICS AT M = 4.3 OF MONOPLANE, TRIFORM AND CRUCIFORM SLENDER DELTA WING BODIES WITH ALL-MOVING TAIL CONTROL SURFACES
D. Treadgold and D. Pierce 1968 205 p refs Supersedes RAE-TR-66343; ARC-28800
(ARC-CP-1014; RAE-TR-66343; ARC-28800) Copyright. Avail: CFSTI; HMSO £1 15s 6d

Supersonic wind tunnel tests were made over an incidence range from - 4 to + 30 degrees for a range of roll angles on a series of conical slender delta wing and body combinations with a short afterbody on which a rectangular tail control surface is mounted. An examination is made of the characteristics of the wing and body combination and the approximate contributions of the individual wing panels are deduced. The effectiveness of the tail control surfaces as stabilisers and as controls is examined for three different sizes of gap between the control and the wing trailing edge. The non linear behaviour of the controls tested is attributed at low incidences to the viscous losses due to the wing wake, and at high incidence to the influence of the expansion field from the wing trailing edge. Author (ESRO)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N69-19683# National Physical Lab., Teddington (England). Aerodynamics Div.
A PASSIVE D-WEIGHTING NETWORK SIMULATING THE INVERSE OF THE 40-noy CONTOUR
W.C. Copeland and L.A. Burdon Jul. 1968 12 p ref
(NPL-AERO-AC-34) Avail: CFSTI

A passive network is described which provides the D-weighting response curve defined as the inverse of the '40-noy contour'; permissible tolerances on the component elements are discussed. The network is intended to facilitate direct measurement of perceived noise level, an approximation to which is obtained by adding 7 dB to the D-weighted sound pressure level. Author (ESRO)

N69-19747# Royal Aircraft Establishment, Farnborough (England).
CONCORDE: SUMMARY OF THERMAL FATIGUE TESTS ON SPARS REPRESENTING WING SPARS OR RIBS [SYNTHESE DES ESSAIS DE FATIGUE THERMIQUE SUR POUTRES REPRESENTANT DES LONGERONS OU NERVURES DE VOILURE]
Aug. 1968 120 p Transl. into ENGLISH from a French report
(RAE-LIB-TRANS-1305) Avail: CFSTI

Thermal fatigue tests on spars representing wing spars or ribs of Concorde are reported and summarized. The aim of the tests is to study different possible designs for those parts of the structure subjected to thermal stresses. The Appendix examines theoretically the sensitivity of thermal stresses to a number of variables which might be modified to accelerate a thermal fatigue test. Author

N69-19765# Aeronautical Research Council (Gt. Brit.)
ATMOSPHERIC TURBULENCE AND AIRCRAFT HEIGHT-KEEPING ACCURACY
B. A. M. Piggott 1968 31 p refs Supersedes RAE-TR-67195; ARC-29841
(ARC-CP-1009; RAE-TR-67195; ARC-29841) Copyright. Avail: CFSTI; HMSO 6s

As a contribution to the study of vertical separation standards for use in air traffic control, an examination is made of the possibility of applying the spectral methods already used in gust load evaluations to the problem of determining the height-keeping errors caused by atmospheric turbulence. Although it is found that the data available on the low frequency components of atmospheric turbulence and on the nature of the control applied by the pilot, whether human or automatic, are not sufficient to allow an accurate estimation of these errors, it is concluded that they do not make a significant contribution to the total errors experienced. It is noted, however, that certain atmospheric phenomena lie outside the scope of the theory used here. Author (ESRO)

N69-19766# Aeronautical Research Council (Gt. Brit.)
STABILITY AND CONTROL FLIGHT TESTING. SOME OF THE TEST INSTRUMENTATION REQUIREMENTS
R. Rose 1968 15 p Presented at the 13th AGARD Flight Mech. Panel on Flight Test Instrumentation, Montreal Supersedes RAE-TR-67108; ARC-29277
(ARC-CP-1015; RAE-TR-67108; ARC-29277) Copyright. Avail: CFSTI; HMSO 6s

The scope of stability and control flight testing at R.A.E. Bedford and the type of physical measurements are briefly reviewed. Suggested overall accuracies for the quantities, including the effects of transducer/recording element and readout system, are stated. Particular emphasis is put on the need for good instrumentation dynamic characteristics and the need for accurate dynamic calibrations of the instruments. The overall accuracies achieved using photographic trace recording systems is of the order 2% - 3%, whilst 1% is required and exceptionally, for special tests, 0.2%. The use of digital/magnetic tape systems looks attractive to meet these requirements, but flight experience has shown that the potential accuracy of this system may not be achieved. The need for proving new sophisticated instrumentation systems in real flight environments is stressed. Author (ESRO)

N69-19857# Federal Aviation Administration, Washington, D. C.
RELATIONSHIP OF T/F CAS TO FUTURE T/F SYSTEMS
Philip J. La Rochelle *In its* Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 1–6 (See N69-19856 09-14)
Avail: Issuing Activity

Discussed are time frequency and integrated system developments in maintaining synchronous time for an improved aircraft collision avoidance system. Precise time ordering techniques utilizing three second epochs, each epoch being divided into 2000 individual "time slots" of 1500 μs each, are used in maintaining time to the accuracies of ± 0.5 μs, 3 sigma. Only one aircraft transmits in a time slot and thus the mutual interference problem is eliminated. Since sufficient system design and comparative analyses have not been made to date to justify the use of T/F for civil air traffic control, world wide and ground station timing requirements for the singular CAS function have to be developed. G.G.

N69-19858# Federal Aviation Administration, Washington, D. C.
REVIEW OF THE COLLISION AVOIDANCE PROBLEM AND DISCUSSION OF T/F CAS GROUND STATION FACTORS
Owen E. McIntire *In its* Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 7–22 (See N69-19856 09-14)
Avail: Issuing Activity

A number of diagrams and charts are presented to graphically depict the basic collision avoidance system and its related time frequency ground station factors. The illustrations describe: (1) the CAS problem; (2) the need for a cooperative T/F CAS; (3) the desirability of national standards; (4) the T/F CAS technique; (5) the syncronization problems and (6) accuracy requirements. G.G.

N69-19865# Air Force Systems Command, Wright-Patterson AFB, Ohio. Radio Navigation and Beacon Branch.
APPLICATION OF TIME/FREQUENCY TECHNIQUES IN MILITARY STATIONKEEPING
Robert L. Huff *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 71–83 (See N69-19856 09-14)
Avail: Issuing Activity

This discussion of time/frequency techniques will be limited to military applications involving stationkeeping requirements for a system to permit close formation flying in bad weather and at night. Of the several solutions proposed by industry, one offered the one-way ranging concept using time/frequency techniques. One-way ranging is possible through the use of precisely synchronized crystal oscillator clocks in each aircraft as a common time reference for extracting range information from the arrival time of pulsed R–F energy. Transmission of this energy is initiated by one local clock at one assigned time. If all clocks in the other aircraft in the formation are precisely aligned with the master clock, then all receiving stations know both the assigned transmission time and the measured arrival time of the pulsed R–F energy. Consequently, the propagation delay is known at all receiving stations, and therefore the range to the transmitting station. Author

N69-19898*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMICS OF TOWED DECELERATORS
James Franklin Campbell (M.S. Thesis—Va. Polytech. Inst.) Jan. 1968 67 p refs
(NASA-TM-X-61528) Avail: CFSTI CSCL 01A

A preliminary investigation was undertaken to determine theoretically the geometric and aerodynamic parameters which have the greatest influence on the stability and performance of the nonporous towed decelerator. A mathematical model was generated to describe the flexible tow line–decelerator dynamical system as a rigid two body problem. The resulting second order governing differential equations of motion were used to obtain the characteristic equation (quartic) describing the coupled motions of the two bodies. Evaluation of the coefficients of the quartic yielded expressions which illustrate when the dynamical system is unquestionably unstable. The two single-degree of freedom cases investigated were the motion of the decelerator about its nose and the motion of the rod and decelerator about the pivot point. For both of these cases expressions were derived for the natural angular frequency, damping factor, steady-state solution, and time to damp to one-half amplitude. Author

N69-19924# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
AN ANALYSIS OF THE POSSIBILITY OF REDUCTION OF SONIC BOOM BY ELECTRO-AERODYNAMIC DEVICES
Sin-I Cheng and Arnold Goldburg Sep. 1968 94 p refs
(D1-82-0764) Avail: Issuing Activity

An investigation of the physics of electro-aerodynamic techniques for reducing the sonic boom and conclusions as to the usefulness of the proposed techniques are presented. An analysis of the interaction of ions and electrons of an electric discharge with neutral particles in moving air according to a one-dimensional model is described and analyzed. A simple expression for the change of total stream thrust (the usual stream thrust, $p + \rho u^2$, less the electric pressure $E^2/8\pi$) by the electric wind mechanism is given. The electric power required for maintaining the discharge is calculated. With these basic results, the specific power requirement of the electro-aerodynamic devices proposed for deflecting the oncoming air of the supersonic transport is evaluated to be of the order of 1 watt/dyne (1/2 megawatt/pound force). Author

N69-19950*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EXPERIMENTAL VERIFICATION OF SCALE FACTORS FOR PARAWING OPENING CHARACTERISTICS WITH DIMENSIONAL RATIOS FROM 1:1.3 TO 1:3
Robert H. Moore, David L. Eichblatt, and Theodore F. Hughes Washington Mar. 1969 41 p refs
(NASA-TN-D-5071) Avail: CFSTI CSCL 01C

Verification of an analytical scaling technique by experimental drop tests under controlled conditions is presented in which opening characteristics of full scale flexible parawing and an intermediate scale model are predicted from results of model testing. Two methods of scaling are considered, dynamic similarity and wing loading. Dynamic similarity is derived from comparing similar forces in the equation of motion of scale models to those of a prototype. Wing loading is similar but differs by requiring the payload-weight-per-canopy area of all parawings to be the same. Three scaled, all flexible parawings with keel lengths of 8, 16, and 24 feet were tested at initial opening velocities ranging from 48 to 90 feet per second. Results are presented in the form of comparisons of actual and predicted tension, acceleration, velocity, and distance time histories. Author

N69-20113*# Technology, Inc., Dayton, Ohio.
STATISTICALLY PREDICTING MANEUVER LOADS FROM EIGHT-CHANNEL FLIGHT DATA Final Report
Larry E. Clay and Heber L. Short Jan. 1968 177 p refs
(Contract NASw-1335)
(NASA-CR-100152; TI-168-68-1) Avail: CFSTI CSCL 01B

From the data of a given aircraft, a maneuver model technique was developed which represented each maneuver type by a set of normalized parameter time histories, each independent of the given aircraft type. With proper denormalizing, the maneuver model can be applied in statistically predicting the maneuver-induced fatigue loads on any aircraft type. Thus the maneuver model could form a part of the structural design criteria. This technique was used to predict peak fuselage, wing, horizontal tail, and vertical shear load distributions from 450 hours of F-105D eight-channel oscillograph

data. Favorable correlation of the predicted load peaks with load peaks calculated in the conventional fashion demonstrated the feasibility of the maneuver model technique. In an independent effort, a computer program was developed to determine the feasibility of automatically recognizing and classifying the maneuvers in eight-channel data digitized on magnetic tape. Using a magnetic tape bearing data from fourteen F-105D flights, an evaluation test showed that the program recognized 90 percent of all maneuvers and correctly classified 90 percent of the maneuvers recognized.
Author

N69-20178# Goodyear Aerospace Corp., Akron, Ohio.
INVESTIGATION OF POWERED LIGHTER-THAN-AIR VEHICLES Final Report, 14 Nov. 1966–27 Nov. 1968
Jerome J. Vorachek. Nov. 1968 110 p refs
(Contract F19628-67-C-0047)
(AD-680829; GER-14076; AFCRL-68-0626) Avail: CFSTI CSCL 1/3

A study of previously built LTA aircraft led to a comperison study of two concepts for a high-altitude mission, both powered with air-breathing engines: the first an aerodynamically shaped airship flown to and from the 70,000 foot design altitude; the second a naturally shaped balloon, free-ballooning to altitude, powered for 24 hours against 10 knot winds, and payload and powerplant parachuted to earth after the flight. The air-breathing engines appeared marginal on normal fuels, but the advantages of smaller total volume and lower constructional cost clearly favored the naturally shaped balloon for this 10-knot wind requirement. A parametric study of this naturally shaped balloon, electrically-powered, was undertaken. Boundaries were 60,000 to 100,000 feet altitude, airspeeds 0 to 45 knots, and flight durations 12 to 96 hours. The altitude and time limits can be achieved at an airspeed of 15 knots. For this shaped balloon, 45-knot speeds are not practical. It is recommended that the naturally shaped balloon with electric propulsion system be built and flown to demonstrate the concept.
Author (TAB)

N69-20221# Aerospace Medical Research Labs. Wright-Patterson AFB, Ohio.
SONIC BOOMS RESULTING FROM EXTREMELY LOW-ALTITUDE SUPERSONIC FLIGHT: MEASUREMENTS AND OBSERVATIONS ON HOUSES, LIVESTOCK AND PEOPLE Final Report
C. W. Nixon, H. K. Hille, H. C. Sommer, and Elizabeth Guild Oct. 1968 31 p refs
(AD-680800; AMRL-TR-68-52) Avail: CFSTI CSCL 20/1

Sonic booms generated by F-4C aircraft flying low-level terrain-following profiles during Joint Task Force II operations near Tonopah, Nevada, were recorded under and near the flight tracks, and responses of structures, animals, and people were observed. Recorded overpressures up to 144 psf were analyzed, correlated with available aircraft operations data, and compared with data from different aircraft flying similar profiles. Observations of structures, animals, and people were correlated with the measured overpressures. Results include acquisition of near-field recordings of overpressures generated by the F-4C, the finding that sonic window glass fragments were propelled a short distance rather than falling directly below the window, an instance in which the measured overpressure of a sonic boom 1 mile to the side of the track far exceeded the predicted value, the finding that livestock (undetermined prior exposure to acoustic stimuli in this situation) did not respond adversely to the sonic booms, confirmation that very intense sonic booms do not harm people directly and the reaffirmation that the selection of site locations for low-level supersonic training missions will continue to pose a problem.
Author (TAB)

N69-20270 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
AERODYNAMICS OF A MACH 7 AIRPLANE [AERODYNAMIQUE D'UN AVION A MACH 7]
R. Ceresuela Nov. 1968 24 p refs In FRENCH
(B-852) Avail: CFSTI

In order to identify the aerodynamic problems related to engine size and to emphasize the special features of high sweep airplanes, an experimental wind tunnel program has been carried out on a Mach 7 airplane model. The first results of force measurements, obtained in the whole range from subsonic to supersonic, are presented with particular emphasis upon the contribution of nacelles and fins on the aerodynamic characteristics. Guidelines followed in hypersonic airplane research are discussed.
Author

N69-20304 Air Force Systems Command, Wright-Patterson AFB, Ohio.
FLY-BY-WIRE FLIGHT CONTROL SYSTEMS
J. P. Sutherland 3 Sep. 1968 7 p Presented at Joint Meeting of Flight Mech. and Guidance and Control Panels of AGARD
(C-153-10) Avail: CFSTI

An introduction to fly-by-wire and an outline of state-of-the-art fly-by-wire techniques are presented. An outline of the philosophy of fly-by-wire flight control systems is given, the evolution of fly-by-wire is discussed, the advantages of fly-by-wire over mechanical systems are listed, current fly-by-wire techniques are outlined, and a brief review of the Air Force Flight Dynamics Laboratory propoeed in-house and contracted fly-by-wire development programs is given.
Author

N69-20381 Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
VTOL IFR TECHNOLOGY PROGRAM
John H. Kearns, III and Robert A. Bondurant, III Sep. 1968 6 p Presented at AGARD Symp. on Advanced Control System Concepts, Oslo, 1968
(C-153-4) Avail: CFSTI

The program is concerned with achieving an instrument flight rule (IFR) operational capability for VTOL weapon systems in a manner which maximizes flight safety for the pilot. The stress is on design requirements and criteria associated with the transition and hover regions of flight. Development of the necessary control-display-guidance technology is outlined; the principle of the control-display concept is that the pilot is an active element of the control loop at all times. This is achieved through the use of the force steering concept. A computer provides command information to both the pilot and the autopilot. The CH-3C helicopter used for inflight research, two ground-based helicopter simulators, the Pilot Factors Program (PIFAX) for defining pilot control-display requirements, and instrumentation used in the program are briefly described.
K.W.

N69-20400# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
PRIMARY FLIGHT CONTROL CIRCUIT DEVELOPMENT FROM MECHANICAL SYSTEMS TO AN ALL-ELECTRIC DIGITAL SIGNALLING SYSTEM
K. H. Doetsch and W. Metzdorf Sep. 1968 15 p refs Presented at the Joint Meeting of the Flight Mech. Panel and the Guidance and Control Panel of the AGARD, Oslo, Sep. 1968
(C-153-12) Avail: CFSTI

Design principles, development, and problems of mechanical flight control and stability augmentation systems are reviewed and compared with electric signalling systems (fly-by-wire) as a possible alternative for primary flight control of aircraft. Reliability,

maintenance, and inflight repair of the electronic part of a fly-by-wire system and of a failure detection subsystem are briefly examined. The feasibility of digital fly-by-wire systems is discussed, including location of the analog-to-digital and digital-to-analog conversion functions, the digital-to-analog converter in the electrohydraulic servo system, and the electrohydraulic servo system with mechanical feedback. K.W.

N69-20457*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CALCULATED AIRPLANE STOPPING DISTANCES BASED ON TEST RESULTS OBTAINED AT THE LANDING RESEARCH RUNWAY, NASA WALLOPS STATION

W. Pelham Phillips *In its* Pavement Grooving and Traction Studies 1969 p 101–113 refs (See N69-20451 09-11)

Avail: CFSTI CSCL 01B

Data are presented from an analytical study made to predict improvements in adverse weather landing and balanced take-off field performance levels for transversely grooved runways. The results indicate that the use of the landing research runway transverse groove configuration (1-inch pitch by 1/4-inch width by 1/4-inch depth) effectively reduces landing field lengths for the Convair 990A and McDonnell Douglas F-4D airplanes under adverse weather conditions on a variety of runway surfaces. In addition, essentially dry balanced field take-off performance is attainable for grooved runway surfaces in a wet and puddled condition, since grooving increases the critical engine failure speed to practically dry surface values. Only slight reductions in balanced field lengths are provided by grooving for take-offs from slush covered runways. Author

N69-20463*# Strategic Air Command, Beale AFB, Calif.

EFFECT OF GROOVED-RUNWAY OPERATIONS ON AIRCRAFT TIRE WEAR AT BEALE AIR FORCE BASE, CALIFORNIA

David S. McRae *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 165–183 (See N69-20451 09-11)

Avail: CFSTI CSCL 01C

Grooving of the runway at Beale Air Force Base, California, was completed in February 1968. As part of the follow-on test program, tire wear has been monitored for the B-52G, KC-135, and T-38 aircraft operating at the base. Of these three aircraft, only the KC-135 has shown a sustained decrease in tire life since grooving was completed. Chevron shaped cuts have been occurring on retread B-52G and KC-135 tires since grooving was completed. Preliminary results indicate that these cuts have little effect on tire wear or operational parameters. Author

N69-20464*# Ogden Air Materiel Area, Hill AFB, Utah.

SOME EXPERIENCE WITH TIRE WEAR AND DAMAGE ON GROOVED RUNWAYS

Robert H. Hout *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 185–188 (See N69-20451 09-11)

Avail: CFSTI CSCL 01C

The Ogden Air Material Area (OOAMA), Hill Air Force Base, Ogden, Utah, has the prime responsibility for new tires for out-of-production aircraft and the total responsibility for the retread tire program of the U.S. Air Force. Since March 1968, this command has become increasingly alarmed with tire tread stripping problems associated with the B-52 and KC-135 aircraft. It was not until July 1968 that OOAMA associated the grooved runway at Beale Air Force Base, California, as the primary contributory cause of this problem. Some recent published reports are claiming extensive improvements in traction with no tire damage during braking on grooved runways at slip ratios up to and well beyond peak braking. Contrary to these published reports, the Air Force is experiencing considerable damage to cargo and bomber type aircraft tires. Considerable damage is also being inflicted on tires on some aircraft that are performing only touch-and-go training missions. This damage is being experienced on both new and retreaded tires. OOAMA is presently exploring a new tire procurement program which involves a special testing program to evaluate wear and performance of each manufacturer's tire. The Air Force then procures tires based on performance instead of low bid price. This program is inducing manufacturers of new and retread tires to produce improved designs for competition. Author

N69-20465*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NASA STUDIES ON EFFECT OF GROOVED RUNWAY OPERATIONS ON AIRCRAFT VIBRATIONS AND TIRE WEAR

Thomas J. Yager *In its* Pavement Grooving and Traction Studies 1969 p 189–201 ref (See N69-20451 09-11)

Avail: CFSTI CSCL 01C

Some tire tread wear data obtained from tests conducted at the Langley landing loads track for a variety of aircraft tire sizes and types on various transversely grooved surfaces are presented and discussed. Comparative tire tread wear data and main strut vibration data obtained during the McDonnell Douglas F-4D and Convair 990 aircraft tests on grooved and ungrooved surfaces at the landing research runway at NASA Wallops Station are also discussed. Within the test limitations of these studies the results indicate that transversely grooved runway surfaces do not significantly increase aircraft vibrations or tire tread wear. Author

N69-20466*# Thompson Aircraft Tire Corp., San Francisco, Calif.

A SURVEY OF THE EFFECT OF GROOVED RUNWAY OPERATIONS ON THE WEAR OF COMMERCIAL AIRLINE TIRES

James M. Peterson *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 203–212 refs (See N69-20451 09-11)

Avail: CFSTI CSCL 01C

Commercial airlines have been exposed to grooved runways for less than 2 years. The investigation of worn commercial aircraft tires indicates that grooved runways have not contributed to any apparent change in tire-wear patterns. The incidence of chevron cutting has increased since grooved runways have become operational, but these superficial cuts have not been considered to be detrimental to aircraft tire wear. Author

N69-20475*# Ministry of Technology, London (England).

JOINT NASA BRITISH MINISTRY OF TECHNOLOGY SKID CORRELATION STUDY: RESULTS FROM BRITISH VEHICLES

R. W. Sugg *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 361–409 ref (See N69-20451 09-11)

Avail: CFSTI CSCL 01B

Speed friction results are given from the three British friction vehicles which were engaged in the Joint NASA-Ministry Skid Correlation Trials at NASA Wallops Station. The degree of correlation between the vehicles and aircraft is demonstrated and the ability of the equipment to place the test surfaces in the same friction order as the aircraft is discussed. An investigation is made into the ability of two of the equipments to predict aircraft stopping distances. Braking-force coefficients in the anti-skid, locked-wheel and impending-skid friction conditions are compared, also the effect of changes in tire pressure. A comparison is made with a standard aircraft tire prior and subsequent to the introduction of blind pin holes in the tread which were intended to provide an additional way of escape for water in the tire-ground contact area. Author

N69-20529# Boeing Co., Seattle, Wash.

A DEVELOPMENT IN COCKPIT GEOMETRY EVALUATION

Leo F. Hickey, Wayne E. Springer, and Francis L. Cundari (ONR) Nov. 1968 54 p refs Presented at the AGARD-NATO Symp. on Problems of the Cockpit Environment, Amsterdam, 11–14 Nov. 1968

(Contract N00014-68-C-0289)

(AD-680799; D6-53594) Avail: CFSTI CSCL 1/3

The overall problem of cockpit evaluation is discussed. Within this context, the specific problem of cockpit geometry evaluation is explored. Known methods for evaluating geometry (the physical layout of the entire cockpit complex-displays, controls, seats, personal equipment, windshield/canopy, interior surface shape, openings for ingress and egress) are summarized. Their advantages and disadvantages are presented. The application of modeling techniques that take advantage of computer capability to improve geometry evaluation is discussed. A research program, in progress, directed toward the full development of a computerized model of the physical aspects of flight crewmen and any cockpit configuration is presented in some detail. Author (TAB)

N69-20533# Air Vehicle Corp., San Diego, Calif.
LIFTING SURFACE THEORY AND TAIL DOWNWASH CALCULATIONS FOR V/STOL AIRCRAFT IN TRANSITION AND CRUISE
E. S. Levinsky, H. U. Thommen, P. M. Yager, and C. H. Holland Oct. 1968 116 p refs
(Contract DAAJ02-67-C-0059)
(AD-680969; USAAVLabs-TR-68-67; Rept-356) Avail: CFSTI CSCL 1/3

A large-tilt-angle lifting-surface theory is developed for tilt-wing and tilt-propeller/rotor V/STOL aircraft. The method is based upon an inclined actuator disc analysis in which closed-form solutions are obtained for the velocity potential at large distances behind the actuator surface. Both the normal velocity and the nonlinear pressure boundary conditions are satisfied exactly across the slipstream interface. The inclined actuator disc analysis is combined with a discrete-vortex Weissinger-type lifting surface theory. Wing-propeller combinations at arbitrary wing angle of attack, propeller tilt angle, and thrust coefficient are considered. Multiple slip-stream effects including slipstream rotation are introduced. Agreement between theory and experiment is shown to be satisfactory for small slipstream inclination angles. However, at large angles the theory (with an undeformed, but displaced, slipstream and wake) predicts significantly lower downwash angles in the tail region than shown by the test data, possibly due to slipstream deformation and wake roll-up. Use of only one-half the calculated wake displacement gave improved agreement at these conditions. However, insufficient data are available for making a general evaluation of the theory at large angles. Extensive digital computer results are given in chart form, showing span loading, downwash angle, stability parameter, and dynamic pressure at arbitrary points behind the wing for V/STOL configurations with two and four slipstreams. Author (TAB)

N69-20547# Boeing Co., Renton, Wash. Commerical Airplane Div.
A SPOT COMPUTER PROGRAM FOR CALCULATING THE STATISTICAL DISTRIBUTION OF SOLAR RADIATION INTENSITY ON AIRPLANE SURFACES
A. J. P. Lloyd 9 Dec. 1968 56 p
(AD-680992; D6-20409-1TN) Avail: CFSTI CSCL 1/3

A SPOT computer program for calculating the statistical distribution of the intensity of solar radiation incident on surfaces of an airplane is described. The basic theory for the program is given, and two applications are included. Author (TAB)

N69-20618# Aeronautical Research Council (Gt. Brit.)
LOW-SPEED WIND-TUNNEL MEASUREMENTS OF PRESSURE FLUCTUATIONS ON THE WING OF A TWIN-JET AIRCRAFT (BRISTOL 188)
J. A. Lawford and A. R. Beauchamp 1968 32 p refs
Supersedes RAE-TR-66399; ARC-29230
(ARC-R/M-3551; RAE-TR-66399; ARC-29230) Copyright. Avail: CFSTI; HMSO 14s

Root-mean-square intensities and spectra of local pressure fluctuations were measured by transducers at two positions on the inner part of the wing and four on the outer part, while low-frequency pressure fluctuations on the upper surface were obtained at a further fifteen positions on the outboard part of the wing by a 'creeper' and transducer. The low-frequency component of pressure and load fluctuations increases in intensity with increasing incidence; on the inboard wing this increase is fairly abrupt and is associated with a change in the form of the mean flow field about the wing; on the outer wing the intensity increases more gradually with incidence. Buffet boundaries have been assessed tentatively from the incidence associated with rapid rise of load fluctuation on the inner wing; more severe limitations could however be imposed by conditions on the outer wing, where likely buffeting excitation is more difficult to assess. Leading-edge strakes may modify the buffet boundaries, giving a gain of about 0.2 in usable C_L trimmed. There is some evidence that leading-edge droop would considerably reduce load fluctuations. Author (ESRO)

N69-20665# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALUCLATED PARAMETERS OF AIR-CUSHION DEVICES WITH NOZZLE DEVICE AT HOVERING CONDITION
V. Khanzhonkov Jan. 1968 12 p Transl. into ENGLISH from Rechnoi Transport (USSR), v. 25, no. 6, 1966 p 25–27
(AD-681060; FTD-HT-23-1277-67) Avail: CFSTI CSCL 1/3

Hovering over a solid surface is one of the fundamental conditions for which calculations of the aerodynamic and power characteristics of an ACV must be made. By the method presented for calculating an ACV with a double-flow annular-nozzle arrangement, the power characteristics and aerodynamic parameters for the fan can be found if the weight of the vehicle, its hovering height, airflow configuration, and the nozzle arrangement are known. A formula is derived for finding the power required per ACV unit weight, which varies with the ratio G/S (G = weight of the ACV; S = overall area of the nozzles). Author (TAB)

N69-20678# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE TURBO-ELECTRIC VTOL AIRCRAFT, SUPPLEMENTAL INFORMATION
David W. Rabenhorst Sep. 1968 17 p
(Contract NOw-62-0604-c)
(AD-681338; APL-TG-1013A) Avail: CFSTI CSCL 1/3

In TG-1013 (AD-675 332) a unique aircraft propulsive/lift power distribution system was described that promises a great deal of flexibility in the design of VTOL aircraft. Its use would permit a significant improvement in many aspects of present and future VTOL designs, including performance, safety, cost, operability, noise, applicability, and operational economy. In this supplement (TG-1013A), a number of interesting additional Turbo-Electric applications that have been evolved since the publication of TG-1013 are described. Author (TAB)

N69-20694# Colorado Univ., Boulder.
SCIENTIFIC STUDY OF UNIDENTIFIED FLYING OBJECTS, VOLUME 1 Final Report
Edward U. Condon Jan. 1969 434 p refs
(Contract F44620-67-C-0035)
(AD-680975; AFOSR-69-0025TR) Avail: CFSTI CSCL 1/2

The report contains the results of a scientific inquiry into the phenomena of Unidentified Flying Objects. This volume contains: (1) Conclusions and recommendations, (2) Summary of the study, and (3) Case studies predating the term of the project. Author (TAB)

N69-20695# Colorado Univ., Boulder.
SCIENTIFIC STUDY OF UNIDENTIFIED FLYING OBJECTS, VOLUME 2 Final Report
Edward U. Condon Jan. 1969 450 p refs
(Contract F44620-67-C-0035)
(AD-680976; AFOSR-69-0026TR) Avail: CFSTI CSCL 1/2

The report contains the results of a scientific inquiry into the phenomena of Unidentified Flying Objects. This volume contains: (1) Case studies during the term of the contract, (2) Photographic case studies, and (3) Historical aspects of UFO phenomena. Author (TAB)

N69-20696# Colorado Univ., Boulder.
SCIENTIFIC STUDY OF UNIDENTIFIED FLYING OBJECTS. VOLUME 3 Final Report
Edward U. Condon Jan. 1969 529 p refs
(Contract F44620-67-C-0035)
(AD-680977; AFOSR-69-0027TR) Avail: CFSTI CSCL 1/2

The report contains the results of a scientific inquiry into the phenomena of Unidentified Flying Objects. This volume contains: (1) The scientific context, (2) Appendices A-X, and (3) The index. Author (TAB)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N69-19705*# Exotech, Inc., Washington, D. C.
HANDBOOK OF SPACE ENVIRONMENTAL EFFECTS ON SOLAR CELL POWER SYSTEMS
William C. Cooley and Matthew J. Barrett Jan. 1968 228 p refs
(Contract NASw-1345)
(NASA-CR-100327) Avail: CFSTI CSCL 10B

This handbook provides a review of research data and analytical methods which can be used to design radiation resistant silicon solar cell power systems for earth satellites, which have orbits passing through the magnetosphere, and for spacecraft exposed to solar flares and micrometeoroids. Only limited data are included on the damage by low energy protons (below 5 MeV) because an adequate analytical method for predicting their effects is not yet available. Only data on solar cells made of silicon have been included. Author

N69-19772# Sandia Corp., Albuquerque, N. Mex. Technical Libraries Div.
DISCHARGE OF A CONDENSER BATTERY [ENTLADUNG EINER KONDENSATORBATTERIE]
Hans-Joachim Belitz and Erwin Kugler [1968] 14 p refs Transl. into ENGLISH from Elektrotech. Z. (West Berlin), no. 87A, 1966 p 560–563
(SC-T-68-1551) Avail: CFSTI

The harmonic vibrations that occur during the discharge of condenser batteries are analyzed. The amplitudes and frequencies are obtained. A FORTRAN program was used in the calculations. NSA

N69-19799*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESCRIPTION AND EVALUATION OF DIGITAL-COMPUTER DESIGN-ANALYSIS PROGRAM FOR HOMOPOLAR INDUCTOR ALTERNATORS
David S. Repas and Gary Bollenbacher Washington Mar. 1969 93 p refs
(NASA-TN-D-5072) Avail: CFSTI CSCL 10A

A digital computer program for analyzing the electromagnetic design of homopolar inductor alternators is presented. The program, which is written in FORTRAN 4 programming language, is described in general terms. The calculational methods are either outlined briefly or appropriate references are cited. Instructions for using the program are given, and typical program input and output for a 15-kVA alternator are shown. Calculated results for this and two nearly identical 80-kVA alternators are compared with experimental data. In general, considering the many assumptions and approximations which are made in the calculational methods, it is felt that reasonable agreement was obtained between the test data and calculated results. Author

N69-19808*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN APPROACH TO OPTIMUM LOADING OF A SOLAR ARRAY WHICH EXPERIENCES TEMPERATURE CHANGES
Merton Suseman (M.S. Thesis—Va. Univ.) Mar. 1969 86 p refs
(NASA-TM-X-61520) Avail: CFSTI CSCL 10B

A method is described and an example given of how the utilization of a solar array can be optimized. The method consists of choosing an earth-orbiting spacecraft mission and assigning to the mission various environmental and experimental power constraints. Spacecraft power requirements are provided by a solar array. A storage battery stores energy for use during the nonilluminated portion of the orbit. The required solar array is first determined on the basis of a constant-current battery-charging system and then on the basis of a taper-current battery-charging system. It is shown the taper current-charging system results in improved solar array utilization. This conclusion is reached since the solar array, obtained by taper current-charging, is smaller in area, lighter in weight, and less expensive than the constant-current charge array. Taper-current battery-charging is shown to be possible by controlling the operating point of the solar array. Author

N69-19829*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A FORTRAN 4 PROGRAM TO ESTIMATE THE OFF-DESIGN PERFORMANCE OF RADIAL-INFLOW TURBINES
Carroll A. Todd and Samuel M. Futral, Jr. Washington Mar. 1969 49 p refs
(NASA-TN-D-5059) Avail: CFSTI CSCL 10A

This program computes conventional performance parameters at required combinations of speeds and flow rates. Necessary input information consists of flow areas, diameters, blade angles, and an estimate of design point performance. The flow equations and corresponding computer listings are given. A set of example calculations is included. Author

N69-19837# Brookhaven National Lab., Upton, N. Y.
FLUX PUMPS, 60-HZ
R. B. Britton [1968] 4 p ref Presented at the Summer Study on Superconducting Devices and Accelerators, Upton, N. Y., 10 Jun.–19 Jul. 1968 Supported by AEC
(BNL-13019) Avail: CFSTI

The design and operating characteristics of a flux pump, which operates from 60 Hz, are described. NSA

N69-20202# Army Electron Command, Fort Monmouth, N. J. Electronics Components Lab.
PULSED ALKALI-VAPOR LAMPS
John E. Creedon, William Bayha, and Sol Schneider Dec. 1968 11 p refs
(AD-680896; ECOM-3051) Avail: CFSTI

The development of nonreactive tube bodies, such as lucalox and sapphire, has in recent years resulted in increased alkali-metal-vapor lamp research. Presently, sodium vapor lamps are available for lighting applications. Cesium, sodium, potassium, rubidium, and some mixtures of these gases were studied. These studies were directed toward pulse operation, which has been generally neglected by investigators because it was considered

unfeasible. The reason for this is the requirement for high-temperature operation to maintain high gas pressures for efficient light output and the belief that this is inconsistent with achieving a high degree of depth of modulation. Greater than 95% depth of modulation was demonstrated without sacrificing efficiency. The influence of the environmental and operating conditions on the tube design has been determined. Careful consideration has to be given to atmospheric oxidation problems, thermal shocking of the envelope, and selection of electrode materials. These factors can cause early failure owing to end cap leakage, body cracks, or sputtering that reduces the light output. The influence of the mode of operation on the tube design and the failure mechanisms will be discussed.
Author (TAB)

N69-20218# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION ON AN ETSVM COMPUTER OF A SERIES OF ASYNCHRONOUS MOTORS FOR GYROSCOPES
I. N. Orlov et al May 1968 13 p Transl. into ENGLISH from Elektrotekh. (USSR), no. 3, 1966 p 4–6
(AD-681305; FTD-HT-23-14-68) Avail: CFSTI CSCL 9/3

Specific requirements of gyroscope-drive high-speed induction spin motors are formulated, particulars of their design on a digital computer are described, and computation results are presented. Main dimensions of the motor are connected with those of the gyro flywheel. Both nominal and maximum torques are determined by the required acceleration time.
Author (TAB)

N69-20289# Army Electronics Command, Fort Monmouth, N. J.
FUEL CELL MANPACK POWER SOURCE
Galen R. Frysinger, Frank J. Wrublewski, and William L. Dudley Nov. 1968 28 p
(AD-680894; ECOM-3054) Avail: CFSTI CSCL 10/2

Lightweight fuel cells coupled with secondary batteries in a hybrid configuration constitute useful and versatile sources of power. The secondary battery provides required power density and instantly available power while the fuel cell efficiently converts a primary fuel to electrical power at a continuous steady rate to sustain high energy density over extended missions. Miniaturized electronic controls enable automatic system operation for maximum operator simplicity. Electrical output characteristics are suitable for direct operation of electronic equipment with random duty cycles or for recharging secondary batteries. Development of a 30-watt system using a solid form of hydrogen, lithium hydride or sodium aluminum hydride, and a 60-watt system using a liquid form, hydrazine (N_2H_4), has shown concept feasibility. These chemical fuel forms, which can be successfully packaged for field supply, afford an extremely high energy density making the hybrid fuel cell system competitive on cost per kilowatt hour with standard military zinc-carbon primary batteries.
Author (TAB)

N69-20292*# Bose Corp., Natick, Mass.
STUDY AND DEVELOPMENT OF HIGH EFFICIENCY INDUCTION MOTOR AMPLIFIER SYSTEM Final Report
Sherwin Greenblatt and John J. Wawzonek Washington NASA Mar. 1968 155 p refs
(Contract NAS12-588)
(NASA-CR-86128) Avail: CFSTI CSCL 09C

Several areas important to the design of variable speed induction motor systems with variable voltage, and variable frequency drive are examined. These systems are composed of the induction motor, the DC to AC inverter, and an overall control scheme. The AC induction motor is analyzed to determine its inherent capabilities in these systems. Also, the motor is analyzed to determine its impedence and torque characteristics with nonsinusoidal excitation. It is shown that the design of the induction motor should minimize rotor resistance in order to maximize efficiency and to reduce spurious torques due to nonsinusoidal excitation. The DC to AC inverters are reduced to three basic forms: (1) The base band inverter, (2) The cycloconverter, and (3) The pulse modulator. These inverters are analyzed to determine inherent performance capabilities and limitations with various applicable modulation schemes. Design considerations of power processing stages are discussed including an analysis of some thyristor forced commutation schemes. Specific performance requirements for inverters are discussed in terms of motor requirements.
Author

N69-20329 Colorado Univ., Boulder.
END-WINDING LEAKAGE OF HIGH-SPEED ALTERNATORS BY THREE-DIMENSIONAL FIELD DETERMINATION
Mulukutla Sreerama Sarma (Ph.D. Thesis) 1968 450 p
Avail: Univ. Microfilms: HC $20.25/Microfilm $5.75 Order No. 68-12425

It is the purpose of this dissertation to present a new numerical method for the determination of end zone fields and for the calculation of end leakage reactance of high-speed alternators. The method takes account of all boundaries, simplified in regard to their geometries and magnetic nature. A three-dimensional model, in which the discrete nature of the windings is fully taken into account, is used. The stator core end plane is taken to be infinitely permeable, a good approximation to practical conditions. The permeability of the end shields is taken to be either zero or infinity, or assumed to have a finite value. The effects of air gap, slots, and short-pitched winding are considered. The partial differential equations of the end field and the boundary conditions are developed by using the concept of the magnetic vector potential. Subsequently, they are transformed in finite difference expressions. Numerical solutions are then obtained by using successive over- or underrelaxation.
Dissert. Abstr.

N69-20418# Army Electronics Command, Ft. Monmouth, N. J.
FEASIBILITY INVESTIGATION OF PLASTIC PARTS FOR VENTED, NICKEL-CADMIUM BATTERY BB-607( )/U
E. J. Settembre Nov. 1968 20 p
(AD-680893; ECOM-3056) Avail: CFSTI CSCL 10/3

This report presents a feasibility investigation of the use of low cost and lightweight plastics for the BB-607( )/U Battery Assembly. Battery assemblies in two configurations were constructed and evaluated. In these, the cell restraining clamp assemblies, battery hold-downs and battery cases were fabricated of plastics. Lower battery case corners were reinforced with epoxy and bulk voids were filled with urethane foam adding rigidity to the unit and supplying a shaped cavity for the cell assemblies. In addition, an inexpensive transit cover was designed and fabricated. The completed unit weighs 15.5 pounds, compared to 17.0 pounds for the conventional BB-607( )/U. This is a considerable weight saving. The battery assemblies were successfully drop-tested from four (4) feet on a 2 in. fir bed backed by concrete.
TAB

N69-20544# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTER FOR THE DETERMINATION OF OPTIMUM ENERGY SYSTEM CONDITIONS
A. V. Baev et al 12 Apr. 1968 15 p Transl. into ENGLISH from Elektrichestvo (Moscow), no. 6, 1966 p 23–26
(AD-680928; FTD-HT-23-1588-67) Avail: CFSTI CSCL 10/2

A specialized computer consisting of eight main simulating, measuring, search and computing units has been developed at Chelyabinsk Polytechnical Institute. Its purpose is different in that the savings to be gained indirectly in industry by maintaining continuity of supply without voltage deviations are considered to be more important than minimizing the fuel consumption in power stations. With automatic tap-changing of transformers it is proposed to solve this problem first and so solve the load-flow problem, the computer in question being intended for both tasks.
TAB

N69-20548# National Academy of Sciences—National Research Council, Washington, D. C. Committee on Undersea Warfare.
ENERGY SYSTEMS OF EXTENDED ENDURANCE IN 1-100 KILOWATT RANGE FOR UNDERSEA APPLICATIONS
Sep. 1968 133 p refs
(Contract Nonr-2300(08))
(AD-681068; NRC-CUW-0348; PUBL-1702) Avail: CFSTI CSCL 10/2

A report is given on the state of technology of energy systems that may have undersea applications by a select panel. The pertinent features of the most promising among electrochemical and nuclear sources, as well as dynamic conversion and cable transmission systems are discussed in some detail. Related technologies such as hydrogen-oxygen supply systems and heat transfer technology are also summarized. The nature, magnitude and priority of effort required for the Navy to have available several alternatives for meeting its future needs is also detailed. Author (TAB)

N69-20560# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SYSTEM OF HYDRAULIC AUTOMATIC CONTROL ELEMENTS
V. M. Dvoretskiy et al 5 Apr. 1968 15 p refs Transl. into ENGLISH from Avtomat. i Telemekh., Pnevmoavtomat. (Moscow), 1966 p 81–88
(AD-680939; FTD-HT-23-1489-67) Avail: CFSTI CSCL 13/7

Modules comprising a hydraulic control system are described. They are the operational amplifier, the hydraulic differentiator, the hydraulic integrator, the hydraulic capacitor, the hydraulic chokes, and an electro-hydraulic converter. Each of the described modules is shown by a block diagram and fairly extensive performance data are included. Author (TAB)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N69-19619*# National Aeronautics and Space Administration, Washington, D. C.
INFORMATION PROCESSING IN THE FUNCTIONAL VISUAL FIELD [INFORMATIEVERWORKING IN HET FUNKTIONEEL GEZICHTSVELD]
A. F. Sanders Dec. 1967 13 p refs Transl. into ENGLISH of the Rept. No. IZF-1967-6, 1967 16 p
(NASA-TT-F-11408; IZF-1967-6) Avail: CFSTI CSCL 06P

It was found that performance in a number of visual tasks does not linearily decline as a function of visual angle. Instead, there are stepwise drops at two visual angles, which prove to be the boundaries of the areas where inspection by means of peripheral vision and eye movements are sufficient to obtain optimal performance. The drops are explained in terms of strategies in processing visual information, which are thought to vary from grouping signals at small visual angles to successive handling at very large angles. This theory is reevaluated in the light of more recent notions on visual coding and recoding. The relation between grouping and perceptual organization is especially considered. It is concluded that earlier reported work is restricted to the macrostructure of the functional visual field. Author

N69-19626# United Kingdom Atomic Energy Authority, Harwell (England).
RADIOLOGICAL PROTECTION PROBLEMS OF TRITIUM
E. Dietrich and L. A. Koenig [1968] 13 p refs Transl. into ENGLISH from Atompraxis (Germany), no. 13, 1967 p 454–457
(NP-tr-1703) Avail: CFSTI

The properties of tritium that are important in radiological protection are described. The hazards from tritium are internal since it emits very low energy beta particles. Tritium can enter the body via the lungs, the skin, and the intestinal tract. Most frequently tritium is taken in as water or water vapor. Radiological protection measurement problems are described and the most common methods of solving them are discussed. Protection factors relative to tritium-containing water vapor are examined. The techniques used at the Karlsruhe research reactor for tritium control are summarized. NSA

N69-19635# Wisconsin Univ., Madison. Dept. of Radiology.
TRANSMISSION SCANNING WITH SUP 99M TC AND SUP 137 CS
James A. Sorenson and Russell C. Briggs 22 Jul. 1968 3 p ref Presented at the Annual Meeting of the Radiological Soc. of Am., Chicago, Ill.
(Contract AT(11-1)-1422)
(COO-1422-24; CONF-681201-1) Avail: CFSTI

Methods are described for making transmission images of the human chest using ^{99m}Tc or ^{137}Cs as the radiation source. A rectilinear scanner was used. Good transmission scans were obtained with a 10 mCi ^{99m}Tc source but the 6 hr half-life of ^{99m}Tc requires that a new source must be prepared each day. The high energy of a ^{137}Cs source resulted in poor contrast between bone, water, and air space. NSA

N69-19648*# Techtran Corp., Glen Burnie, Md.
THE EFFECT OF TEMPERATURE ON THE CONTENT OF VOLATILE ACIDS IN SEEDS AND LEAVES OF OIL-BEARING PLANTS [VLIYANIYE TEMPERATURY NA SODERZHANIYE LETUCHIKH KISLOT V SEMENAKH I LISTYAKH MASLICHNYKH RASTENIY]
L. P. Zhdanova Washington NASA Mar. 1969 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 182, no. 3, 1968 p 719–722
(Contract NASw-1695)
(NASA-TT-F-12128) Avail: CFSTI CSCL 06A

The content of volatile fatty acids and hydroxy acids in the seeds and leaves of oil-bearing plants is investigated as a function of the various temperature conditions under which the plants mature. The sunflower, poppy, and flax were the plants used in the tests. The results of the tests are summarized. It was found that lower temperatures facilitate the accumulation of fatty acids, and that the leaves are apparently the primary source of low fatty and hydroxy acids for the mature seeds. Author

N69-19714*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY. A CONTINUING BIBLIOGRAPHY WITH INDEXES
Feb. 1969 198 p
(NASA-SP-7011(60)) Avail: CFSTI CSCL 06

Subject coverage is concentrated on biological, psychological, physiological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order are included as well as such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors. Applied research is emphasized, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion. Each entry is accompanied by its abstract. K.W.

N69-19780# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.

METABOLISM AND INTERNAL DECONTAMINATION IN A RAT OF A RADIOACTIVE ZIRCONIUM-NIOBIUM SALT [METABOLISME ET DECONTAMINATION INTERNE, CHEZ LE RAT, D'UN SEL DE ZIRCONIUM-NIOBIUM RADIOACTIF]

Michel Gavend, Jean-Pierre Rinaldi, and Renaud Rinaldi Jan. 1969 20 p refs In FRENCH; ENGLISH summary

(CEA-R-3703) Avail: CFSTI

A study in a rat of the metabolism of a salt of ^{95}Zr-^{95}Nb injected by the intravenous route has allowed to display the following points: (1) the fast decrease of the blood concentration of radioisotopes, the durable accumulation of radioisotopes in the bone, and the strong urinary elimination during the first hours. A study of the possibilities of internal decontamination of ^{95}Zr-^{95}Nb was also carried out. Among all the tested chemicals, only zirconium citrate seems effective. Author (ESRO)

N69-19819# Sloan-Kettering Inst. for Cancer Research, New York.

METHODS AND APPLICATIONS OF QUANTITATIVE COMPUTER-ANALYZED SCANNING. APPENDIX 1

J. S. Laughlin, P. J. Kenny, D. A. Weber, A. J. Dwyer, K. Mayer et al 1968 31 p refs Presented at the Symp. on Med. Radioisotope Scintigraphy, Salzburg, Austria, 6–15 Aug. 1965

(Contract AT(30-1)-910)

(NYO-910-76-APP-1; CONF-680804-6) Avail: CFSTI

A program of metabolic studies was carried out with quantitative procedures during the past decade with a variety of radioisotopes and labeled compounds. These studies demonstrated the capabilities of labeled pharmaceuticals, not only for kinetic studies, but also for diagnostic and localization purposes. Data display options included digital scans, computer-analyzed scans, and photoscans. The radioisotopes used included ^{198}Au colloids, ^{18}F, ^{52}Fe and ^{59}Fe as ferrous citrate, ^{99}Tc as sulfur colloid, ^{99}Tc pertechnetate, and ^{85}Sr. Seven features of the quantitative scanning method are illustrated with both research and diagnostic examples. Author (NSA)

N69-19845# Library of Congress, Washington, D. C. Aerospace Technology Div.

BIOLOGICAL EFFECTS OF MAGNETIC FIELDS

Vladimir Mutschall *In its* Foreign Sci. Bull., Vol. 5, No. 2 Feb. 1969 p 13–36 refs (See N69-19843 09-34)

Avail: CFSTI

The results of the latest Soviet research on the biological effects of magnetic fields, are reviewed. Physicochemical effects on animals and humans are discussed. Author

N69-19846# Library of Congress, Washington, D. C. Aerospace Technology Div.

TOXICITY AND ELECTRON CONFIGURATION

Janice Smith *In its* Foreign Sci. Bull., Vol. 5, No. 2 Feb. 1969 p 37–45 refs See N69-19843 09-34)

Avail: CFSTI

Recent work on the relationship between toxicity of elements and their electron configuration is reviewed. Preliminary studies of the correlation between toxicity (measured by various indices) and the physicochemical properties of elements are described. It was concluded that more clarification of the relationship between toxicity and the relative stability of various electron configurations is needed. Author

N69-19853# Library of Science, Washington, D. C. Aerospace Technology Div.

ATRANES: A NEW CLASS OF PHYSIOLOGICALLY ACTIVE COMPOUNDS

Seraphim Parandjuk *In its* Foreign Sci. Bull., Vol. 5, No. 1 Jan. 1969 p 56–60 refs (See N69-19851 09-34)

Avail: Issuing Activity

Recent open-source Soviet literature dealing with the synthesis, structure, properties, and physiological activity of atranes is reviewed. Author

N69-19894# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

THE USAEC DIVISION OF BIOLOGY AND MEDICINE. VOLUME 1: BIOLOGICAL SCIENCES Annual Report, 1967

R. C. Thompson, ed., Paulette Teal, ed., and Evelyn G. Swezea, ed. May 1968 261 p refs

(Contract AT(45-1)-1830)

(BNWL-714-Vol-1) Avail: CFSTI

The status of research projects in the Division of Biology and Medicine at Battelle-Northwest is reported. The research activities in the following areas are included: radiation effects studies; ^{90}Sr studies in miniature swine; inhalation studies; space nuclear systems studies; radioelement toxicity studies; radioelement removal studies; molecular and cellular level studies; terrestrial ecology studies; and aquatic ecology studies. NSA

N69-20003 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.

COMMUNICATIONS BIOPHYSICS

In its Electron. Lab. Rep. Activities 15 Jul. 1968 p 251–282 refs (See N69-19981 09-34)

(Contract DA-28-043-AMC-02536(E); Grants NIH 1-PO1-GM-14930-02; NIH 5-TO-1-GM-01555-02)

Avail: CFSTI

Marked and consistent changes in click evoked potentials of the deep rat cortex showed a high correlation with changes of sleep and wakefulness. The marked increase in all components of the deep response appear generally to be less variable than the more complex changes in the surface responses. G.G.

N69-20009*# Naval Medical Research Inst., Bethesda, Md. Dept. of Microbiology.

EFFECTS OF HIGH AND LOW BAROMETRIC PRESSURES ON SUSCEPTIBILITY AND RESISTANCE TO INFECTION Quarterly Status Report, 1 Oct.–31 Dec. 1968

Francis B. Gordon and James D. Gillmore 31 Dec. 1968 22 p refs

(NASA Order R-21-010-010)

(NASA-CR-100360; A-3061A(A5-1); QSR-14) Avail: CFSTI CSCL 06S

Animal chamber technology was advanced to allow body temperature maintenance of mice under H_2 environments and a new host–virus test system was developed. Coxsackie B virus–adult mouse. Exposure of mice to 100% O_2 at 3.3 psia before aerosol challenge with *Chlamydia trachomatis* did not result in the increased mortality rate seen in mice exposed after aerosol challenge. A reduction in mortality in mice injected intraperitonially with *C. psittaci* is present in those groups exposed to 77% O_2 after, or before and after injection. Exposure of strain A/HeJ mice to hyperoxia and hypoxia following intravenous inoculation of the carcinogen, dibenzanthracene, resulted in a significantly greater incidence of pulmonary adenomas in the hyperoxic group. K.R.G.

N69-20048 California Inst. of Tech., Pasadena.

VISUAL ACUITY AND EYE MOVEMENTS

David Scott Gilbert (Ph.D. Thesis) 1968 188 p

Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-12739

Evidence supports the hypothesis that eye movements serve to improve acuity. By measuring eye movements during a simple acuity task, and during a control non-acuity task, we have shown that certain patterns of eye movement are characteristic of acuity tasks. Similarly, specific patterns of eye movement are generated during spatial localization tasks. The observations provide circumstantial evidence for the existence of mechanisms by which eye movements mediate acuity and spatial localization information. Through a comparison of acuity for stabilized retinal images with acuity for normal retinal images we have found that eye movements improve acuity very slightly at most, and that even this small improvement may be adequately accounted for by the residual fadeout effects commonly observed during prolonged viewing of stabilized images. Dissert. Abstr.

N69-20138# School of Aerospace Medicine, Brooks AFB, Tex.
BEHAVIORAL AND CIRCULATORY RESPONSES TO X-IRRADIATION DELIVERED AT 200 RADS PER MINUTE TO WHOLE BODY AND TRUNK ONLY Technical Report, Jun.–Nov. 1967
Paul H. Chapman Sep. 1968 13 p refs
(AD-680843; SAM-TR-68-111) Avail: CFSTI CSCL 6/18

Macaca mulatta monkeys performing a continuous avoidance task received high energy x-irradiation delivered to either whole body or trunk only, at a dose rate of 200 rads per minute. Prior to and during the 88-minute period of irradiation, performance and blood pressure were monitored in both groups of subjects. Results support the concept that, at this dose rate of radiation exposure, immediate behavioral changes seen after absorption of relatively low superlethal doses reflect radiation effects on structures located within the trunk of the subject. No significant synergism between head and trunk effects appears to exist. At higher doses, prominent signs of direct central nervous system damage determine the behavioral effect. A phase of partially reversible hypotension is demonstrated after 1,200 to 1,500 rads are delivered at this dose rate. This hypotension appears to be due largely to an effect of radiation on trunk structures. Author (TAB)

N69-20169*# Aztec School of Languages, Inc., Acton, Mass.
PHYSIOLOGICAL PROBLEMS DURING PROLONGED WEIGHTLESSNESS [FIZIOLOGICHESKIYE PROBLEMY DLITEL'NOY NEVESOMOST']
N. N. Gurovskiy et al Washington NASA Mar. 1969 8 p Transl. into ENGLISH of Russian Conf. Paper Presented at the 3d Intern. Symp. on the Basic Environ. Probl. of Man in Space, Geneva, 15–19 Nov. 1968
(Contract NASw-1692)
(NASA-TT-F-12100) Avail: CFSTI CSCL 06S

Physiological problems which occur during prolonged weightlessness are discussed in terms of an analysis of the data obtained from the short-term weightlessness experiment of two dogs on board the Kosmos-110. The phenomena discussed (weight loss, disorder in ionic equilibrium, loss in water of the tissues, etc.) are used to explain how protective measures must be taken for future prolonged space flights. Author

N69-20199*# National Aeronautics and Space Administration, Washington, D. C.
NOTES ON THE STRUCTURE AND FUNCTION OF THE BRAIN: TABLE OF CONTENTS, ABSTRACT, PREFACE AND INTRODUCTION
S. A. Sarkisov Mar. 1969 24 p refs Transl. into ENGLISH from the book "Ocherki Po Strukture i Funktsii Mozga" Moscow, Medicine Publishing House, 1964 p 3–17 Prepared by Frank C. Farnham Co.
(NASA-TT-F-12210) Avail: CFSTI CSCL 06P

A general picture is presented of the entire human and animal central nervous system. Three factors determine the general structure and functional organization of the central nervous system: (1) the character and location of the receptors of the given organ; (2) the character and location of neurons forming the connections between afferent and efferent formations of the nervous system; (3) the character and distribution of the efferent apparatus. The structure of the cortex of the cerebral hemispheres is studied in the following subchapters: (1) the convolutions of the cerebral hemispheres (with illustrations of the inner and outer surfaces), (2) cyto- and myelo-architecture, and (3) myelo-architecture of the cortex. It is stated that the grey matter is richer in blood vessels than the white matter and that the density of the capillary network is related to the number of nerve cells. It is also stressed that the blood circulation in the brain and the spinal cord is mutually dependent on the circulation of the cerebrospinal fluid. Author

N69-20205# Army Foreign Science and Technology Center, Washington, D. C.
GROWTH OF MICROORGANISMS IN MEDIA WITH PETROLEUM FUELS
N. N. Grechushkina 1968 9 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. Ser. Vi: Biol. Pochvoved. (Moscow), v. 23, no. 2, 1968 p 122–124
(AD-680804; FSTC-HT-23-785-68) Avail: CFSTI CSCL 6/13

It was ascertained that representatives of both Mycobacteria and Pseudomonas can grow in kerosene TS-1 and T-1, diesel and hydrogenated fuels. Mycobacteria mucosum and M. lacticolum grow well in kerosene and hydrogenated fuels. Diesel fuel with a sulfur content of 1.6% was utilized slightly by them; gasoline was not used at all. Pseudomonas grow well in kerosene TS-1 and T-1 and diesel fuel, and hydrogenated fuel and gasoline B-70. Thus, of all tested microorganisms, only the strain Pseudomonas pyocyaneum can grow in aeronautical gasoline. The intensity of growth of various strains of the same bacteria in the same fuel is not uniform. Author (TAB)

N69-20251# Charles F. Kettering Research Lab., Yellow Springs, Ohio.
SPECTRAL LIGHT REQUIREMENTS OF ALGAE Final Report, 1 Jul. 1965–1 Jul. 1967
Thomas E. Brown Oct. 1968 228 p refs
(Contract DA-19-129-AMC-565(N))
(AD-680972; TR-69-45FL82) Avail: CFSTI CSCL 6/3

Seventeen species of algae representing ten taxonomic divisions were individually grown in white light and light of nine separate 10 nm bandwidths corresponding to the major absorption peaks of known photoactive pigments. Energy levels of the incident light were equalized through the entire series, approximating 15,000 ergs/sq cm/sec. Measurements of growth, pigmentation, photosynthesis, respiration, and where possible, morphology and structure were made following seven to ten days continuous exposure to the light regimes. The rates of photosynthesis and subsequent respiration were determined using the same full light regime as for growth. Light enhancement characteristics and wavelength requirements are shown for these parameters and compositions of specific illumination sources are suggested. Author (TAB)

N69-20259# Army Medical Research Lab., Fort Knox, Ky.
IMPULSE DURATION AND TEMPORARY THRESHOLD SHIFT Interim Report
Michel Loeb and John L. Fletcher 25 Sep. 1968 20 p refs
(AD-680916; USAMRL-791) Avail: CFSTI CSCL 6/19

Subjects were exposed, on different test days, to 106 db (peak, normal incidence) impulses 34, 68, 72, or 98 microsec in duration spaced 1 sec apart. For each pulse duration the subjects were first exposed to one pulse, then the number of pulses was

doubled on successive days until the temporary threshold shift (TTS) following exposure exceeded 30 dB. Intercorrelations of numbers of impulses required to reach criterion TTS at each duration were obtained. There is reason to believe that if one exceeds allowable TTS in the speech range frequencies with this kind of impulse noise, there is a chance of producing permanent high frequency loss. Author (TAB)

N69-20260# Pasadena Foundation for Medical Research, Calif. Dept. of Laser Biology.

THE EFFECT OF LASER ENERGY ON CELLS IN TISSUE CULTURE Annual Summary Report

Donald E. Rounds 6 Jan. 1969 20 p refs

(Contract DA-49-193-MD-2564)

(AD-680946; REPT-1) Avail: CFSTI CSCL 6/18

Ruby laser irradiation causes nonpigmented cells to deposit an agent into the surrounding culture medium which can promote RBC agglutination, blood clotting, WBC chemotaxis and stimulation of cell growth. Blue and green laser wavelengths produce mitochondrial swelling in beating rat heart cells. Morphological changes suggest that a toxic substance is lost from these structures, which results in nuclear pycnosis and death of the cell. A variety of drugs were observed to photosensitize individual mitochondria to an argon laser microbeam. These included various forms of tetracycline, DNP, amytal, and NaF. Author (TAB)

N69-20288# School of Aerospace Medicine, Brooks AFB, Tex.

THE CALCULATION OF RETINAL BURN AND FLASHBLINDNESS SAFE SEPARATION DISTANCES Summary Report, Nov. 1966–Feb. 1968

R. G. Allen, T. J. White, D. J. Isgitt, D. E. Jungbauer, and J. H. Tips Sep. 1968 54 p refs

(AD-680842; SAM-TR-68-106) Avail: CFSTI CSCL 6/5

The report describes a method for calculating safe separation distances from a nuclear fireball from the standpoint of permanent injury (chorioretinal burns) and temporary effects (flashblindness). Weapon characteristics, atmospheric transmission, and the interaction of radiant energy with the eye are discussed. Predicted safe separation distances from a nuclear flash for humans are presented as functions of observer altitude, height of burst, weapon yield, and day or night conditions. Author (TAB)

N69-20318*# Aztec School of Languages, Inc., Acton, Mass.

INVESTIGATIONS OF THE ORIGIN OF NYCTITROPIC MOVEMENTS OF LEAF ORGANS [UNTERSUCHUNGEN UBER DIE ENTSTEHUNG DER SCHLAFBEWEGUNGEN DER BLATTORGANE]

W. Pfeffer Washington NASA Jan. 1969 183 p refs Transl. into ENGLISH from Akad. Wiss. (Leipzig), Abhandl. Math.-Nat., Kl., v. 30, 1907 p 257–472

(Contract NASw-1692)

(NASA-TT-F-11949) Avail: CFSTI CSCL 06C

Research was conducted on the origin of circadian movement periodicity and the significance of light cycling while temperature and other external conditions were maintained constant and at suitable levels. Different types of specimens with good nyctitropic activity and among these, primarily deciduous leaves were taken into consideration. A few results are summarized below. The nyctitropic movements of the leaves and blossoms, irrespective of whether they are carried out as the result of growth of variation, are photonastic or thermonastic reaction phenomena which occur because of the daily change of illumination and/or temperature. Accordingly, the nyctitropic movements disappear in plants which are brought into constant illumination and temperature and do not appear at all in plants which were raised at a constancy of illumination and temperature. After the elimination of the nyctitropic movements the organs are, however, only without movement if autonomous movements leave them which, where they are present, occur as a rule in a much shorter rhythm. B.P.

N69-20319# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS ON EASTERN EUROPE. SCIENTIFIC AFFAIRS, NUMBER 40

25 Feb. 1969 67 p refs Transl. into ENGLISH from various Foreign articles

(JPRS-47526) Avail: CFSTI

Fifty years of operation of the medical faculty at the State University in Sofia, Bulgaria are reviewed. Specifically, the faculty, achievements, and workings of the neurological and psychiatric departments are discussed. An assessment is made of analog computer technology in East Germany. The status of analytical chemistry in Hungary is reviewed. The philosophy and personnel involved with the Polish Academy of Science are presented. The treatment of mustard gas injuries is briefly discussed. B.P.

N69-20358# Oregon State Univ., Corvallis. Radiation Center.

METABOLISM AND PHARMACOLOGY OF INORGANIC AND FLUORINE CONTAINING COMPOUNDS Final Report, 1 Jul. 1964–30 Jun. 1967

Frank N. Dost, Donald J. Reed, Arthur Finch, and Chih H. Wang Wright-Patterson AFB, Ohio (AMRL) Aug. 1968 105 p refs

(Contract AF 33(615)-1799)

(AD-681161; AMRL-TR-67-224) Avail: CFSTI CSCL 6/20

Studies have been made of the toxicology and chemistry of nitrogen trifluoride, tetrafluorohydrazine, chlorine trifluoride, bromine pentafluoride, and oxygen difluoride. Lethality of each agent by inhalation has been determined, as well as estimates of lethality after intraperitoneal administration. Experimental evidence suggests that the lethal effect of interhalogens is by corrosive local destruction of pulmonary surfaces, resulting in failure of gas exchange. Oxygen difluoride is thought to pass intact into the pulmonary cells where it reacts with biochemical reducing systems to ultimately cause cell death and structural failure. The nitrogen fluorides both cause intrinsically lethal levels of methemoglobin formation, but other pharmacologic activity by these compounds or their derivatives may also contribute to their toxic activity. Author (TAB)

N69-20360# Army Medical Research Lab., Fort Knox, Ky.

LASER-INDUCED CHANGES IN THE IMPLICIT TIME AND OSCILLATORY POTENTIALS OF THE MANGABEY Progress Report

Arthur E. Jones, Albert H. Bryan, and Calvin K. Adams 4 Oct. 1968 16 p refs

(AD-680913; USAMRL-793) Avail: CFSTI CSCL 6/5

The ERG of the mangabey was found to be altered by a single laser pulse of low energy density (0.2 J/cm2) which irradiated a large retinal area. ERGs recorded 6 or more days post-exposure showed a depression or absence of the third oscillatory potential. The implicit time of the b wave was significantly shorter ($p < .001$) post-exposure. Replication of the study with testing at 6-10 days and 6 months post-exposure revealed statistically significant post-exposure ERG changes persisting up to 6 months. Author (TAB)

N69-20361# Systems Research Labs., Inc., San Antonio, Tex.

RESEARCH WITH THE PRIMATE EQUILIBRIUM PLATFORM IN A RADIATION ENVIRONMENT Technical Report, Jan.–Sep. 1967

Donald J. Barnes Aug. 1968 15 p refs

(Contract AF 41(609)-2724)

(AD-680748; SAM-TR-68-81) Avail: CFSTI CSCL 6/18

A revised Primate Equilibrium Platform (PEP II) was designed and constructed to further investigate the effects of pulsed ionizing radiation on the equilibrium function. Twenty rhesus monkeys were trained to maintain a platform-horizontal position by the manipulation of a joy stick. Thirteen of the primates received an approximate midhead dose of 1,000 rads, and 6 received an approximate midhead dose of 2,500 rads. One animal was omitted from the final results owing to a technical problem. After irradiation, 13 animals were tested for 1 hour and the remaining 6 animals were tested for 3 hours, as these were actually two separate experiments 4 months apart. The major dependent variable was the time spent on horizontal per trial. Results demonstrated a definitive dose-level effect in the occurrence of early performance decrement. The operational significance of this finding, as well as the recovery phenomenon seen in all cases, indicates the importance of continued research in this area. Author (TAB)

N69-20371# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

MUSCLE FUNCTION AND THE SPACE ENVIRONMENTS OF WEIGHTLESSNESS AND ACCELERATION Final Report, Dec. 1965–May 1967

Stanley J. Myers Jun. 1968 31 p refs

(AD-680801; AMRL-TR-67-162) Avail: CFSTI CSCL 6/19

Little is known about the effects of prolonged weightlessness and acceleration on the muscular system. This survey reviews basic muscle physiology and discusses the possible effects of these space flight stresses on muscle function. Anatomical, biochemical, and electrophysiological methods for evaluating the state of the muscular system are reviewed. A selected annotated bibliography concerned with the effects of weightlessness and acceleration on muscle is also included. Author (TAB)

N69-20384# Eye Research Foundation of Bethesda, Md.

CHROMATICITY AND LUMINANCE EFFECTS ON VISUAL DETECTION Final Report, 1 Apr. 1967–31 Mar. 1968

Carl R. Cavonius, Rudolf Hilz, and Jerome H. Kravitz Nov. 1968 55 p refs

(Contract DA-49-193-MD-2839)

(AD-680938; ERF-RR-2/68-CR) Avail: CFSTI CSCL 5/10

Wavelength discrimination functions were measured with square-wave grating test objects in which alternate sets of bars were illuminated with two different wavelengths. When both wavelengths are made equal in brightness, the wavelength difference required to detect the grating increases monotonically with grating spatial frequency. Since this relation is approximately constant across the visible spectrum, the shape of the wavelength discrimination function tends to be preserved at high spatial frequencies, although much higher wavelength differences are needed to detect the high frequency gratings. Introducing a detectable brightness mismatch between the two wavelengths results in (1) a reduction of the wavelength difference needed to detect a hue difference between adjacent grating bars and (2) a minimum in the threshold wavelength difference versus spatial frequency function. Under these conditions, wavelength difference no longer increases monotonically with spatial frequency. The resulting functions resemble those previously reported for threshold luminance contrast versus spatial frequency. The relation of these results to form detection and to lateral inhibition is discussed. Author (TAB)

N69-20441# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF THE METHOD OF CHARACTERISTICS FOR THE CALCULATION OF FLOW AROUND BLUNTED CONES BY A SUPERSONIC STREAM OF AIR

R. A. Gzhelyak et al 24 May 1968 14 p refs Transl. into ENGLISH from Vychislitel'naya Tsentr. Sb. Rabot (Moscow), no. 7, 1967 p 197–205

(AD-681268; FTD-HT-23-40-68) Avail: CFSTI CSCL 20/4

This article deals with the application of the method of characteristics to calculations of a supersonic region of the flow near a blunt body, and is based on the available data obtained from the detailed analyses of dissociation and ionization processes taking place behind a shock wave. Boundary conditions on the body and shock wave are used in the form which coincides with the case of a perfect gas with constant heat capacities, because all physicochemical processes are considered frozen when passing through a shock front. Calculations of the flow field between the body and shock wave were carried out progressively by regions bounded by the reflected characteristics. The results of the calculations of the air flow past blunt cones are presented as an illustrative example and are compared with those for an equilibrium flow. The comparison of pressure and density distributions along blunt cones is presented in graphical form. TAB

N69-20448# Human Engineering Labs., Aberdeen Proving Ground, Md.

THE EFFECT OF ATTENTION ON AUDITORY EVOKED POTENTIALS

Lynn C. Oatman Oct. 1968 48 p refs

(AD-681207; HEL-TM-15-68) Avail: CFSTI CSCL 6/16

Click-evoked potentials were recorded from unanesthetized cats with electrodes chronically implanted in the auditory cortex, cochlear nucleus, and round window. The clicks (irrelevant stimuli) were presented continuously as background before, during, and after the presentation of a visual discrimination task (relevant stimuli) which attempted to alter the attentive state of the animals. The mean peak-to-peak amplitudes of averaged click-evoked responses from six adult female cats were significantly smaller during attention to the visual discrimination stimuli when compared with the pre-discrimination and control periods. This relationship was present at all electrode placements for five experimental animals with middle ear muscles cut as well as one control animal with middle ear muscles intact. The results suggest that during attention, a central inhibitory mechanism, independent of middle ear muscles, modifies click-evoked responses possibly via the olivo-cochlear bundle which terminates on the hair cells in the cochlea. Author (TAB)

N69-20459# School of Aerospace Medicine, Brooks AFB, Tex.

EFFECT OF HEAD VERSUS TRUNK FISSION-SPECTRUM RADIATION ON LEARNED BEHAVIOR IN THE MONKEY, NOVEMBER 1967–FEBRUARY 1968

Paul H. Chapman and Robert J. Young Aug. 1968 17 p refs

(AD-680740; SAM-TR-68-80) Avail: CFSTI CSCL 6/18

Twenty-two Macaca mulatta monkeys, trained to a discrete avoidance task, were divided into three groups for exposure to either head only, trunk only, or whole-body radiation with a pulsed fission source. A total dose of 6,250 rads was delivered in a 20-msec. pulse. Trained behavior and blood pressure were monitored continuously during the first hour postirradiation. Results indicate that: (1) head or trunk irradiation will produce deterioration in performance; (2) early performance decrement results primarily from a direct effect of radiation on cephalic structures; (3) this head effect is dose-rate dependent; (4) trunk effects are significant in producing a more uniform early decrement and a more severe later decrement; and (5) the hypotensive response seen immediately after whole-body radiation is secondary to radiation effects within the trunk. Author (TAB)

N69-20519 School of Aerospace Medicine, Brooks AFB, Tex.

UNIQUE ALTITUDE CHAMBER FOR INFECTIOUS DISEASE RESEARCH UNDER AEROSPACE PROFILES, AUGUST 1959–MARCH 1968

E. Staten Wynn, Lawrence F. Busch, and Irving Davis Sep. 1968 27 p
(AD-680820; SAM-TR-68-94) Avail: CFSTI CSCL 6/12

An altitude chamber has been developed which is adapted to infectious disease research. Long-term mammalian experimentation can be carried out under pressures ranging from ambient to 50,000 ft. simulated altitude; oxygen contents ranging from near 100% to as low as compatible with mammalian life; PCO2 up to 10%; and temperature from ambient to 10C. Recorders continuously register these parameters and the relative humidity. A lock allows entry without interruption of the experiments. Personnel safety features include individual oxygen regulators, an intercommunication system, windows for visual monitoring, manually operated valves for emergency recompression, an external location of electrical connections and switches, fireproof clothing, and a sprinkler system automatically activated by ultraviolet radiation. A high-intensity unltraviolet unit initially used for decontamination of exhaust gases is being replaced by an incinerator. Ample penetrations are available for telemetry or other instrumentation. Use of gases such as helium, as well as low-level cobalt-60 radiation, can be instituted with minor modifications. Author (TAB)

N69-20520# School of Aerospace Medicine, Brooks AFB, Tex.
AUDIOMETER MODIFICATION AND PULSE-TONE TECHNIC FOR PURE-TONE THRESHOLD DETERMINATION, 15 NOVEMBER 1967–1 MARCH 1968
Vernon C. Bragg and Frederick G. Collins Sep. 1968 12 p refs
(AD-680743; SAM-TR-68-91) Avail: CFSTI CSCL 6/16

The ears of twenty-five people having normal hearing were tested by a single-descent pulse-count procedure of threshold determination. Pulse trains were produced by a modified telephone dial which keyed a manual audiometer. Six frequencies were tested. Results were compared with thresholds obtained using a fixed-frequency instrument of the Bekesy type. No significant differences were found between threshold measures made by the two methods. Test-retest by the pulse-count procedure indicated that reliability compared favorably with that of other threshold measures. The test is recommended for use in clinical audiometry, particularly where assurance is needed that the subject hears at least at a given level. Among examples of its uses are testing candidates for flight training, and bone-conduction testing to predict results of middle ear surgery. Author (TAB)

N69-20524# Army Medical Research Lab., Fort Knox, Ky. Biophysics Div.
CORNEAL INJURY PRODUCED BY CARBON DIOXIDE LASER RADIATION Final Report
Howard M. Leibowitz and George R. Peacock 16 Aug. 1968 40 p refs
(AD-680915; AMRL-787) Avail: CFSTI CSCL 6/5

The pathological effects upon the eye of exposure to infrared laser radiation, emitted by a CO2 laser, was studied. A total of 142 rabbit eyes was irradiated at varying dose levels and each was observed for a period of two months. Within the limits of the power outputs and exposure times considered, clinically detectable ocular damage was limited to the cornea. Five clinical levels of corneal injury were defined and the dosage of CO2 laser radiation capable of producing each level of injury was determined. Author (TAB)

N69-20575# Food and Drug Research Labs., Inc., Maspeth, N. Y.
BIOCHEMICAL DEFENSE MECHANISMS AGAINST PULMONARY IRRITANTS Final Report, 15 Jul. 1966–15 Jul. 1967
Steven Carson and Richard E. Goldhamer Wright-Patterson AFB, Ohio AMRL Oct. 1968 129 p refs
(Contract AF 33(615)-5309)
(AD-680823; AMRL-TR-67-212) Avail: CFSTI CSCL 6/16

Studies were performed in which mammalian mucociliary apparatus has been characterized under normal conditions following exposure to three irritant gases, i.e., 100 per cent oxygen, ozone(O2) and nitrogen dioxide (NO2). Investigations were made in normal and treated animals providing physical, electrophysiological, biochemical, and morphologic data of effects due to exposure. A method for in vitro microscopic observation of viable cilia and adjacent mucus blanket has been described in terms of ciliary beat and movement of particles embedded in the mucus. In vitro volumetric estimation of mucus thickness was compared to electrical resistance measurements in the attempt to provide an in vivo method to determine mucus depth alterations in treated animals. Polarographic studies of oxygen dependent enzymes were carried out on pooled stripped epithelial tissue of untreated animals and comparison made with tissues exposed to ozone and nitrogen dioxide. Exposure to 100 per cent oxygen caused a significant but selflimiting decrease in mucus velocity and viscosity. Acute exposure to nitrogen dioxide (35 and 75 micrograms per kilogram) caused marked dose dependent changes in velocity and viscosity. Exposure to 0.5 ppm ozone for a 14 day period resulted in general mucostasis and elevated viscosity levels. Author (TAB)

N69-20576# School of Aerospace Medicine, Brooks AFB, Tex.
BEHAVIORAL AND PHYSIOLOGICAL RESPONSES OF MACACA MULATTA MONKEYS TO SUPRALETHAL DOSES OF RADIATION
Robert J. Young, Paul H. Chapman, Donald J. Barnes, G. Carroll Brown, and Charles M. Hurst Sep. 1968 33 p refs
(AD-680746; SAM-TR-68-73) Avail: CFSTI CSCL 6/18

Eighteen primates (Macaca mulatta) were trained to a Multiple Avoidance Program (MAP). Tasks requiring visual, auditory, and tactile discriminations were included in this program. Thirteen behavioral and three physiologic variables were analyzed for radiation effects at dose levels of 2,500, 3,750, and 5,000 rads up to 1 hour after irradiation. The analysis of all variables demonstrated a significant change across time (irradiation effect). When an analysis of variance was accomplished, no significant statistical differences were found between dose levels for any of the variables examined in this paper, possibly because of the small number of subjects per group. In two future reports the data examined in this experiment will be compared with subsequent data gathered on the identical variables and dose levels at differing dose rate and neutron-gamma ratios. Author (TAB)

N69-20585# RAND Corp., Santa Monica, Calif.
PREREQUISITES FOR CHEMICAL THERMODYNAMIC MODELS OF LIVING SYSTEMS
James C. DeHaven Nov. 1968 127 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-680760; RM-5691-PR) Avail: CFSTI CSCL 6/1

A discussion of the mathematical techniques and physicochemical concepts involved in the construction of certain types of biological models for use in computer simulation. The basic tools employed are a mathematical method and a computer program to calculate the composition of multiphased chemical systems, given the values of certain combinations of state-determining parameters (chemical inputs, temperature, pressure). A steady-state approach is used because the scientific basis of thermodynamics is better developed than that of kinetics, the mathematical treatment is easier, and many biological systems are either in or closely approach steady states in their chemical composition. Selection of a physiological function or subsystem to be investigated depends on (1) the availability of technological tools; (2) established data; (3) whether it is conveniently factorable from a larger system so that it can be studied over a range of conditions when removed from its normal environment; (4) no feedback effects as a result of changes in the subsystem. An illustrative model of respiratory gases interacting with an aqueous phase is constructed. Author (TAB)

N69-20593# Texas Univ., Austin. Radiobiological Lab.
VISUAL ACUITY PERFORMANCE OF NORMAL AND CHRONIC FOCAL-HEAD IRRADIATED MONKEYS
A. A. McDowell and W. Lynn Brown. Randolph AFB, Texas School of Aviation Medicine Dec. 1958 5 p refs Sponsored by USAF
(AD-681070; SAM-59-5) Avail: CFSTI CSCL 6/18

Monkeys were tested on each of eight visual acuity problems presented in order of increasing difficulty. The results of the study reflected differences between chronic focal-head irradiated monkeys and normal monkeys with respect to performance on these problems. Most efficient performance was shown by the control animals, intermediate efficiency of performance by the animals with previous focal-head irradiation of the posterior association areas, and least proficient performance by the animals with previous focal-head irradiation of the frontal association areas. Author (TAB)

N69-20596# School of Aerospace Medicine, Brooks AFB, Tex.
NEAR VISUAL ACUITY UNDER LOW-LEVEL RED AND WHITE LIGHT Technical Report, Oct.-Jan. 1968
Richard H. Dohrn Oct. 1968 15 p refs
(AD-680845; SAM-TR-68-119) Avail: CFSTI CSCL 6/16

The near visual acuity of 17 subjects between the ages of 35 and 45 years was measured under white light and red light of a 0.1 ft.-L luminance level. The near visual acuity was significantly better under white light for the acuity demands of 20/30, 20/40, and 20/50. The visual acuity was equally good under red or white light when the acuity demand was 20/70 or larger, and the visual acuity was equally poor under red or white light when the acuity demand was 20/20. Author (TAB)

N69-20639# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
STRONTIUM-90 CONTENT OF HUMAN BONE COLLECTED IN 1967 [TENEUR EN STRONTIUM 90 D'OS HUMAINS PRELEVES EN 1967]
Lucien Jeanmaire and Francois Patti Jan. 1969 13 p In FRENCH; ENGLISH summary
(CEA-R-3681) Avail: CFSTI

This report follows raport CEA-R-3381 and presents the strontium-90 content of human bones collected in 1967 in the Paris area. The main trend is much the same as during 1966; contamination levels are decreasing in infants up to 5 years old. Beyond this age, the values are the same or slightly increased. Author (ESRO)

N69-20651# School of Aerospace Medicine, Brooks AFB, Tex.
BATCH FEEDING STUDIES ON HIGH-SOLIDS ACTIVATED SLUDGE FOR TREATING CONCENTRATED HUMAN WASTE, JANUARY-JUNE 1967
Michael J. Ryan and Richard L. Miller Sep. 1968 21 p refs
(AD-681127; SAM-TR-68-108) Avail: CFSTI CSCL 6/11

As part of a continuing Air Force research effort toward the development of a biologic waste management system for closed environments, studies were conducted on a miniaturized activated sludge process for treating concentrated human wastes. During a 40-day continuous run, a prototype sludge reactor was fed batchwise (daily) with an increasing quantity of mixed human waste. Removal of chemical oxygen demand (COD) and the quality of the clarified process effluent were monitored as functions of time and the feeding rate. Author (TAB)

N69-20679# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
AUDITORY SENSITIVITY IN THE RHESUS (MACACA MULATTA) AND THE WHITE-THROATED CAPUCHIN (CEBUS CAPUCHINUS) MONKEYS: A COMPARISON OF THREE TECHNIQUES Final Report, Feb. 1967-Feb. 1968
Leslie W. Dalton, Jr. Oct. 1968 64 p refs
(AD-681135; ARL-TR-68-14) Avail: CFSTI CSCL 6/16

Audiograms were determined in 8 cebus and 4 rhesus monkeys using conditioned suppression, the Galvanic Skin Response (GSR) and the Evoked Cortical Response (ECR). The 3 procedures were compared as to sensitivity, reliability, rapidity, and complexity. Author (TAB)

N69-20682# Japan Atomic Energy Research Inst., Ibaraki. Div. of Health, Physics and Safety.
MICRODOSIMETRY: THE NEW CONCEPT OF THE DOSIMETRY
T. Numakunai, S. Ohtani, and K. Kawai Aug. 1968 44 p refs In JAPANESE; ENGLISH summary
(JAERI-4047) Avail: CFSTI

Problems of radiation dosimetry and quality factor were discussed, along with fundamental concepts of radiation biology, chemistry, and many other fields. New concepts of microdosimetry, microscopic distribution of energy transfer, and density in irradiated medium and correlations between these informations and final effects were proposed. Two theories of microdosimetry were introduced and some characteristics included in the primary energy transfer were discussed. Author

N69-20699# School of Aerospace Medicine, Brooks AFB, Tex.
RADIOPROTECTION WITH 2-(1 DECYLAMINO) ETHANETHIOSULFURIC ACID IN THE RHESUS MONKEY Technical Report, Feb.-May 1968
Robert M. Paull and George S. Melville, Jr. Sep. 1968 14 p refs
(AD-680844; SAM-TR-68-110) Avail: CFSTI CSCL 6/18

An attempt was made to provide radioprotection of the Macaca mulatta primates by the use of 2-(1 decylamino) ethanethiosulfuric acid, a long chain, lipid-soluble compound. The animals were divided into seven groups: two drug control groups, one radiation control group, and four treatment groups. Each treatment group received a different dosage of drug or had a different latent period between administration of the drug and total-body irradiation. Clinical parameters were monitored and one animal from three of the treatment groups as well as two drug controls were necropsied and examined for signs of radiation damage or drug toxicity. Survival times were compared between treated animals and controls. Results indicate that this compound, given as described, does not afford the predicted degree of radioprotection. Author (TAB)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N69-19608*# Bellcomm, Inc., Washington, D. C.
LAUNCH-MAN SEQUENCING FOR EXTENDED MISSION EFFECTIVENESS STUDY
L. D. Nelson 16 Dec. 1968 27 p
(Contract NASw-417)
(NASA-CR-100321; TM-68-1033-6) Avail: CFSTI CSCL 06S

The possible man mission resupply schedules that exist subject to a set of fixed constraints and capable of several sets of desired properties are determined. Those schedule types which maximize various measures of effectiveness are singled out. Three of the fixed constraints aid in defining an initial segment of a man

mission resupply schedule; the derived eleven initial segments partition all admissible mission profiles into eleven classes; the classes, and the schedules, are analyzed via their initial segments. The analyses are performed by constructing charts exhibiting the capabilities of the initial segments with respect to the 54 sets of desired properties, reducing the charts by deleting every initial segment less capable than some remaining segment, and extracting the maximum duration entry for each set of desired properties. Other measures of effectiveness analyzed are number of astronauts exposed, mission duration/number of launch vehicles and number of astronauts/number of launch vehicles. Author

N69-19842*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

A SYSTEMS ANALYSIS OF A REGENERATIVE CABIN ATMOSPHERE CONTROL SYSTEM

Robert D. Averill (M.S. Thesis—Va. Univ.) Aug. 1968 135 p refs

(NASA-TM-X-61517) Avail: CFSTI CSCL 06K

A systems analysis of a regenerative cabin atmosphere control system of the type suitable for earth-orbiting manned missions up to 1 year in length is presented. A typical atmospheric control system was selected based on recent studies of the most suitable components which were currently available. An extensive review of the literature indicated that very few pertinent references were available on the subject of the closed-loop response of atmospheric control systems for life support. A dynamic nonlinear model of the cabin atmosphere control system was developed and this was simplified to a small-excursion linear model for purposes of applying classic stability criteria. The nonlinear model was programed on an electronic analog computer and sample cases were run at various conditions. The study demonstrated that the cabin atmosphere control system model was basically stable but that recovery from large transients was marginal due to component limiting. Author

N69-19700* Darling (R. E.) Co., Inc., Bethesda, Md.

STUDY OF HOSE AND CONNECTORS IN LIFE SUPPORT SYSTEMS Final Report, 23 Feb. 1968–1 Mar. 1969

W. R. Sylvester, R. C. Dougherty, and C. J. Vallery 25 Feb. 1969 56 p

(Contract NAS9-7764)

(NASA-CR-99541; REDAR-RER-121) Avail: CFSTI CSCL 06K

The scope of work covered in this report: (1) the investigation of non-flammable materials capable of fabrication into flexible oxygen hose for spacecraft life support systems, (2) the design and prototype fabrication of a hose connector and (3) the fabrication of a flame barrier for protecting oxygen hose. A thorough discussion of flammability testing and material evaluation is included. Author

N69-19844# Library of Congress, Washington, D. C. Aerospace Technology Div.

ONE-YEAR TEST OF LIFE SUPPORT SYSTEMS

Boris Mandrovsky *In its* Foreign Sci. Bull., Vol. 5, No. 2 Feb. 1969 p 1–12 refs (See N69-19843 09-34)

Avail: CFSTI

A one year sealed chamber experiment conducted in the Soviet Union is described. Its purpose was to determine the ability of human subjects to survive on artificial life support systems, in a chamber of limited size, for extended periods of time. Air and water were regenerated by physicochemical life support systems; food consisted of vacuum-dried products and fresh vegetables from a "cosmic" greenhouse. The success of the experiment was considered to be of value in solving the problem of supporting human life beyond the confines of the earth. Author

N69-19902*# Environmental Research Associates, Randallstown, Md.

CORRELATION STUDY OF THE SIMULATION OF GEMINI EXTRAVEHICULAR ACTIVITY WITH FLIGHT RESULTS

Harry L. Loats, Jr., G. Samuel Mattingly, and G. M. Hay Washington NASA Feb. 1969 199 p refs

(Contract NAS1-7142)

(NASA-CR-1146; ERA-67-7) Avail: CFSTI CSCL 22A

The water immersion simulation of the Gemini EVA utilized full-scale mockups of the Gemini vehicle including portions of the Agena target vehicle with valid replicas of ancillary EVA equipment such as tools, astronaut maneuvering unit, etc. All important items were maintained in a neutrally bouyant condition. Bio-instrumentation was incorporated into the Gemini flight suits and continuous voice and film records were obtained. The water immersion simulation of the Gemini extravehicular activity provided a valid training time line for performance of complex extravehicular tasks and provided adequate measures of the level of work entailed. A second capability evidenced as a result of the program was the method for evaluating various competitive hardware concepts such as tools and motion restraints. The technique used in the preflight evaluation and training was to perform the simulation run with ERA subjects prior to actual performance of the training run by the astronaut. This technique permitted pre-evaluation of hardware in a repetitive manner and served to assess the validity of the water simulation mode. Factors such as drag-damping and orientational stability were compensated by variation of the mockup orientation and configuration. Author

N69-20001 Massachusetts Inst. of Tech., Cambridge, Electronics Lab.

LINGUISTICS

In its Electron. Lab. Res. Activities 15 Jul. 1968 p 221–240 refs (See N69-19981 09-34)

(Contract DA-28-043-AMC-02536(E); Grant NIH MH-13390-02)

Avail: CFSTI

Compatibility between phonetic clicks and ejectives in a variety of the Hottentot language is studied by analyzing the velar glottalic affricative type clicks that are different from the rest of the click phonemes and by transposing this classification into our system of distinctive features. Stridency turns out to be the true distinctive feature of the dialect affricates and of the four clicks described. Also discussed is the vowel system in Faroese language. G.G.

N69-20033# Ohio State Univ., Columbus. Dept. of Aviation.

EXPERIMENTAL TRAINING PROGRAM UTILIZING AN INTEGRATED VFR-IFR CURRICULUM Final Report

M. Faster and W. Hubbard Aug. 1968 198 p

(Contract FA67WA-1814)

(FAA-DS-68-24) Avail: Issuing Activity

A curriculum which combines the teaching of the private pilot flight skills with those necessary for full instrument privileges in the National Airspace System was designed and evaluated. The evaluation consisted of implementing the curriculum using an experimental group of zero time students and comparing their flight performances with those of two control groups. The private pilot control group and the instrument rating control group used the appropriate FAA approved school curriculum. The integrated VFR-IFR curriculum called for 75 total flight hours in about 60 periods. A key feature of this curriculum was the introduction of all pertinent maneuvers using instrument references first and then followed by visual references. The relationships between the two sources of information were emphasized. The experimental curriculum, although producing a superior private pilot, failed to develop the complex skills, judgment, and command ability necessary for the instrument rating. Author

N69-20134# RAND Corp., Santa Monica, Calif.
AIRCREW RATIO STUDIES: A CONTINUATION
Alan J. Gross Dec. 1968 69 p ref
(Contract F44620-67-C-0045)
(AD-680783; RM-5843-PR) Avail: CFSTI CSCL 5/9

A probability model was developed for aircrew ratios that accounts for unscheduled as well as scheduled sorties. Considered are factors of aircraft and crew utilization, reserve crew requirements, and unscheduled sortie requirements. A Poisson distribution is assumed for the number of unscheduled sorties and a probability distribution is assumed for the number of planes per sortie. Formulas are derived for the number of scheduled flights during the flying period, for a generalized crew ratio, for the additional crews expected to be scheduled, and for variance in number of additional crews. A JOSS program is given for calculating aircrew ratios based on the model. The basic parameters are: (1) sortie rate per day per aircraft; (2) proportion of time a crew is scheduled to fly; (3) proportion of time a crew is scheduled in reserve. Tables are provided for determining the crew ratios when these parameters are varied. It can be concluded from the model that crew ratios increase as (1) the proportion of unscheduled sorties increases, (2) crew unavailability increases, and (3) sortie rates increase. Also, reserve crew scheduling affects crew sensitivity when the reserve scheduling proportion is relatively high. Author (TAB)

N69-20224*# Texas Christian Univ., Fort Worth. Dept. of Psychology.
FRACTIONATION OF DISTANCE IN SIMULATED SPACE
Robert P. Markley, Bill R. Brown, and Malcolm D. Arnoult 30 Nov. 1968 27 p refs
(Grant NGR-44-009-018)
(NASA-CR-73306) Avail: CFSTI CSCL 05I

Sixteen subjects (S) made halving and doubling judgments of the distance of an object over two ranges in a simulated outer space. The psychophysical functions obtained were consistent with previous findings. The effects of response procedure, relative effectiveness of distance cues, distance range differences, and S's accuracy in judgments were discussed. Author

N69-20236# Army Medical Research Lab., Fort Knox, Ky.
COUPLING EFFECTS AND PERFORMANCE IN VIGILANCE TASKS Progress Report
Jimmy L. Hatfield and David R. Soderquist 30 Aug. 1968 27 p refs
(AD-680912; USAMRL-789) Avail: CFSTI CSCL 5/10

This investigation examined the performance of 32 Ss on two (auditory and visual) 90-min vigilance tasks. Conventional and TSD indices were obtained as a function of coupling, sense mode, and time on task. Order effects, correlations between sense modes, and possible effects of observing responses were also examined. Hits and false alarms were noted. There was no significant decline in d over time on task for either sense mode or coupling condition. In general, data on conventional measures of performance was similar for both auditory and visual tasks, regardless of the coupling conditions. Significant cross-modality correlations were obtained. The results are discussed in terms of expectancy theory and an observing response model. Author (TAB)

N69-20298# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
PERIPHERAL VISION CUES: THEIR EFFECT ON PILOT PERFORMANCE DURING INSTRUMENT LANDING APPROACHES AND RECOVERIES FROM UNUSUAL ATTITUDES
Paul E. Young, A. Howard Hasbrook, N. S. Daniels, T. L. Dalbow and R. J. Melton May 1968 20 p refs
(AM-68-12) Avail: CFSTI

A previous study utilizing a Convair 340 aircraft simulator showed that peripheral vision cues relating to bank angle significantly improved pilot performance while flying high altitude holding patterns during simulated instrument conditions. This current study explores the effects of similar peripheral vision cues on the performance of 20 ATR pilots during a more exacting task (simulated instrument landing approaches) in a Boeing 720 jet aircraft simulator. Recoveries from unusual attitudes were also investigated. Results of the study suggest that peripheral vision cues (1) improve control of bank angle during instrument approaches; (2) may be safely substituted in an emergency for a failed attitude indicator; and (3) result in significantly less time being required for recovery from unusual attitudes. Significantly, no "reversals" were observed during recoveries utilizing peripheral vision cues. Author

N69-20303# Federation of American Societies for Experimental Biology, Washington, D. C. Life Sciences Research Office.
A STUDY OF FACTORS THAT AFFECT THE PERFORMANCE OF ARMY FLIGHT CREW PERSONNEL Interim Report
Jan. 1969 46 p refs
(Grant DAHC19-68-C-0001)
(AD-681239) Avail: CFSTI CSCL 6/19

The study was conducted as a portion of a comprehensive review of the biomedical aspects of human performance, to provide the Office of the Chief of Research and Development with the most current information on the performance of the soldier. The report identifies the need for performance requirements and reviews the factors that influence the performance proficiency of Army flight crew personnel. Author (TAB)

N69-20385# Applied Psychological Services, Wayne, Pa. Science Center.
A PORTABLE TEST BATTERY FOR COMPARATIVELY EVALUATING OPERATOR PERFORMANCE IN FULL-PRESSURE SUIT ASSEMBLIES Final Report, Jun. 1967–Mar. 1968
Arthur I. Siegel and Richard S. Lanterman Wright-Patterson AFB, Ohio AMRL Oct. 1968 89 p refs
(Contract F33615-67-C-1755)
(AD-680825; AMRL-TR-68-74) Avail: CFSTI CSCL 6/17

Recommendations for a portable battery of tests to assess human mobility in full-pressure suits are presented. The literature was reviewed to determine the types of instruments and tests employed by prior investigators. Task analyses were performed on three advanced vehicles to determine the body member-movement families most frequently involved. A set of tests and measurements is suggested for those member-movement families found to be most frequently involved in advanced flight. Necessary future steps for realizing the portable battery are suggested. The test battery recommended includes the Purdue Peg Board for finger dexterity, a specially designed apparatus for the strength of various body movements, a single dimension tracking task for various coordination tests, a Leighton Flexometer, and direct measurement devices for range of movement and static anthropology measurements. Author (TAB)

N69-20386# Hamilton Standard, Windsor Locks, Conn.
ENGINEERING DESIGN STUDY OF A SPACE SUIT WITH AN INTEGRATED ENVIRONMENTAL CONTROL SYSTEM Final Report, 1 Jul. 1967–30 Jun. 1968
Douglas C. Howard Wright-Patterson AFB, Ohio AMRL Oct. 1968 167 p
(Contract F33615-67-C-1948)
(AD-680826; AMRL-TR-68-122) Avail: CFSTI CSCL 6/11

Continued success in coping with the space environment has led to increased crewman confidence in his ability to perform useful work during extraterrestrial missions. Future missions will

require advanced suit/life-support-system concepts. Such a concept might logically take the form of a space suit for extravehicular activity with an integrated environmental control system. A design study of this concept has been performed and drawings prepared in sufficient detail to permit fabrication of a working model in a suitably equipped model shop. Integration of the environmental control system within the hard torso of the suit assembly resulted in a system having a packaging density approaching 80 percent and able to pass through a 27 inch diameter hatch. The system will support a crewman working at 375 Kcal/hour for an indefinite time to a recharge in space capability. Author (TAB)

N69-20447# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE CONNECTION OF METRICS OF VISUAL AND AUDIO SPACES FOR A METHOD OF TRANSFORMING AN IMAGE INTO SOUND

V. G. Grishin 3 May 1968 10 p refs Transl. into ENGLISH from the book "Vsesoyuznaya Nauchn. Sessiya. Posvyashchennaya Dnyu Radio (220): Sekts. Bioniki Dokl." Moscow, 1966 p 55–60
(AD-681260; FTD-HT-23-1666-67) Avail: CFSTI CSCL 6/4

The author elsewhere proposed and studied experimentally methods for image-to-sound conversion aiming at unburdening the vision of operators. It is of interest to study the given transformation algorithm from the point of view of general criteria of the pattern recognition theory without direct connections with operator psychology. Consequently, the criteria, such as the interval between the classes of images and metric parameters of classes in N-dimensional index spaces within which one can realize (as points) arbitrary classes, are investigated mathematically. Technical limitations are compared with the results of mathematical simplifications of the exact theory. Author (TAB)

N69-20483# Stanford Univ., Calif. Dept. of Computer Science.

MACHINE LEARNING OF HEURISTICS

Donald Arthur Waterman (Ph.D. Thesis) Dec. 1968 226 p refs
(ARPA Order SD-183; ARPA Order 457)
(AD-681027; SU-CS-118; SU-AI-74) Avail: CFSTI CSCL 6/4

First, a method of representing heuristics as production rules is developed which facilitates dynamic manipulation of the heuristics by the program embodying them. This representation technique permits separation of the heuristics from the program proper, provides clear identification of individual heuristics, is compatible with generalization schemes, and expedites the process of obtaining decisions from the system. Second, procedures are developed which permit a problem-solving program employing heuristics in production rule form to learn to improve its performance by evaluating and modifying existing heuristics and hypothesizing new ones, either during a special training process or during normal program operation. Third, the above-mentioned representation and learning techniques are reformulated in the light of existing stimulus-response theories of learning, and five different S-R models of human heuristic learning in problem-solving environments are constructed and examined in detail. Experimental designs for testing these information processing models are also proposed and discussed. Finally, the feasibility of using the aforementioned representation and learning techniques in a complex problem-solving situation is demonstrated by applying these techniques to the problem of making the bet decision in draw poker. This application, involving the construction of a computer program, demonstrates that few production rules or training trials are needed to produce a thorough and effective set of heuristics for draw poker. Author (TAB)

N69-20509# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

VISUAL SEARCH AND DETECTION UNDER SIMULATED FLARE LIGHT Final Report

Robert Hilgendorf Aug. 1968 24 p refs
(AD-681129; AMRL-TR-68-112) Avail: CFSTI CSCL 6/16

Preliminary laboratory research on methods for evaluation aerial flare sources and for optimizing their placement are described. Ten subjects performed target acquisition (detection and recognition) tasks under simulated flare light and ten, serving as controls, under simulated daylight conditions. Generally, target acquisition required an average of approximately 90 seconds under four simulated Mark 24 flares dropped 0.25 mile apart and ignited at 2,000 feet, compared with an average of about 15 seconds under simulated sunlight (simulating those light conditions characteristic of a partly cloudy day). Target location contributed significantly to response times. There were no statistically significant differences in response times between the two types of targets used (trucks and antiaircraft weapon sites). Author (TAB)

N69-20512# System Development Corp., Santa Monica, Calif.

A MATHEMATICAL MODEL OF TRANSFORMATIONAL GRAMMARS

Seymour Ginsburg and Barbara Partee (Calif. Univ., Los Angeles) 18 Jun. 1968 61 p refs
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(AD-680784; SDC-TM-738/048/00; SR-21; AFCRL-68-0470)
Avail: CFSTI CSCL 5/7

A mathematical model of transformational grammars is presented which incorporates most current versions. Among other things, the model has a formal definition of transformations and a general scheme for ordering them. Numerous examples are given to illustrate the theory. Author (TAB)

N69-20534# School of Aerospace Medicine, Brooks AFB, Tex.

THE USE OF YELLOW LENSES IN AIR FORCE OPERATIONS

Benjamin Kislin, J. W. Miller, Benjamin G. Martin, and Richard H. Dohrn Sep. 1968 44 p refs
(AD-681119; SAM-TR-68-93) Avail: CFSTI CSCL 17/8

It was suggested that yellow lens spectacles would provide aircrew in defoliation missions with an easier recognition capability in distinguishing treated areas from virgin jungle. Correspondingly, spectrophotometric analyses of filter lenses and photographic transparencies of terrain were made. Also, the yellow Kalichrome C ophthalmic lens during low-level training flights at 500 to 1,000 ft. and at speeds of 450 to 500 kn were evaluated by F-4 pilots. TAB

N69-20536# Little (Arthur D.), Inc., Cambridge, Mass.

WATER VAPOR REMOVAL SYSTEM Final Report, 15 Nov. 1965–15 Mar. 1968

John M. Ketteringham and Heinz P. Beutner Wright-Patterson AFB, Ohio AMRL Oct. 1968 101 p refs
(Contract AF 33(615)-3385)
(AD-681164; AMRL-TR-68-42) Avail: CFSTI CSCL 6/11

An investigation has been undertaken of a novel method for the dehumidification of air that would be of particular utility in manned space enclosures. The method relies on the unique permeation behavior of gas vapor mixtures through microporous membranes under a pressure gradient. Under appropriate conditions a microporous membrane can become virtually semipermeable to the vapor component (water) of a gas-vapor mixture (humid air). A search was made for the most suitable microporous membrane for this purpose. The fundamental characteristics of the permeation process were studied for selected membrane materials. Prototype dehumidification units were then constructed of the best membrane material, a porous silica glass, and tested. A prototype approximating a one-man capacity was submitted for evaluation. Author (TAB)

N69-20548# Whirlpool Corp., St. Joseph, Mich. Life Support Dept.
STORAGE-DISPENSER DEVICE FOR CUBES ABOARD A SPACE VEHICLE
John J. Symons and Norman G. Roth, and William J. Martin Oct. 1968 13 p
(Contract F41609-67-C-0059)
(AD-680840; SAM-TR-68-62) Avail: CFSTI CSCL 6/11

The purpose of the study was to determine the feasibility of constructing a food cube dispenser-storage device that would provide a higher food-to-package weight and volume ratio than that achieved with present feeding systems for long-endurance spacecraft flights. The program included: a literature search; the formulation and screening of possible concepts. Author (TAB)

N69-20564# Oregon Univ., Portland. Dental School.
ORAL IMAGE INTENSIFIER FOR MILITARY USE Annual Summary Report
Bhim Sen Savara, William L. Parker, and James W. Irwin Sep. 1968 10 p refs
(Contract DADA17-67-C-7168)
(AD-680967) Avail: CFSTI CSCL 6/12

An oral image intensifier with peripheral equipment was designed and prototyped. The device utilizes a small number of short X-ray pulses, which form an image inside the mouth on a phosphor covering the end of a fiber optic bundle. The fiber optic bundle is curved and carries the low light level image outside of the mouth to a small image intensifier, which amplifies the image to a visual level. A closed circuit TV system further amplifies the image and presents it on a monitor. When the project is completed, the entire system will fit into one or two medium sized suitcases. Author (TAB)

N69-20603# Systems Research Labs., Inc., Dayton, Ohio.
DEVELOPMENT OF VISUAL SIMULATION MODIFICATIONS FOR FIELD EVALUATION Final Technical Report, Jul. 1967–Jun. 1968
Larry D. Holden Wright-Patterson AFB, Ohio AF Human Resources Lab. Oct. 1968 102 p refs
(Contract F33615-67-C-1965)
(AD-681175; AFHRL-TR-68-3) Avail: CFSTI CSCL 5/9

The purpose of this effort was to develop modifications on an SMK-23 Visual Simulator Attachment for determining the training value of various types of visual simulation system configurations. This report documents the required modifications to the SMK-23 television system to convert it from projected field sequential color operation to projected high resolution monochrome. Also documented is the replacement of the projection system with a high resolution monochrome lens-monitor system. A comparative evaluation of the original SMK-23 television system and the two modified display systems is presented. An improved SMK-23 model lighting system is described which enhances the television display contrast and yet uses only 20% of the original light power. Author (TAB)

N69-20687# Scientia Research Labs., Inc., Seattle Wash.
MICROBIOLOGIC STUDIES OF THE ACTIVATED SLUDGE PROCESS FOR THE RECYCLING OF HUMAN WASTES Final Report, 1 Jun. 1963–31 Dec. 1964
Robert W. Okey and Frederic T. Santler Brooks AFB, Tex. School of Aerospace Med. Sep. 1968 50 p refs
(Contract AF 41(609)-1974
(AD-681126; TR-68-77) Avail: CFSTI CSCL 6/11

A study of the metabolic characteristics of the bacteria present in activated sludge has been carried out. The organisms were isolated employing standard bacteriologic technics. After isolation, the isolates were examined in Warburg studies and in substrate depletion studies. The substrates studied were the common constituents of human feces and urine, and additional materials such as cellulose, and soaps and detergents not easily replaced in remote environments. Author (TAB)

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N69-19620*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INVESTIGATION OF A DUAL RESONANT CAVITY ABSORPTION CELL USING THE DOUBLE-RESONANCE MICROWAVE SPECTROSCOPY MODULATION TECHNIQUE
Major Clinton Lee (M.S. Thesis—Va. Univ.) Aug. 1968 39 p refs
(NASA-TM-X-61524) Avail: CFSTI CSCL 07D

The application of a dual resonant cavity absorption cell composed of two Fabry–Perot interferometers mounted at right angles in a suitable vacuum enclosure to observe the double resonance effect is investigated. Each interferometer is excited by an independent microwave source. The double-resonance transition is modulated by one source and the modulation induced on the RF absorption in the orthogonal cavity detected. Experimental data are presented to show signal amplitude variations for the two connected transitions of methylene chloride, $0_{00} \rightarrow 1_{11} = 36,087.0$ MH_z and $1_{11} \rightarrow 2_{02} = 15,911.9$ MH_z, as sample pressure, microwave power levels, and cavity Q's were varied. Sensitivities obtained are comparable to those of conventional Stark modulated microwave spectrometers and further improvements are anticipated as higher frequencies are studied. Author

N69-19637# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Radiochemie.
COMPLEX FORMATION OF FIVE- AND SIX-VALENT ACTINIDE ELEMENTS WITH ALPHA-HYDROXY CARBONIC ACIDS [DIE KOMPLEXBILDUNG FUNF- UND SECHSWERTIGER ACTINIDENELEMENTE MIT ALPHA-HYDROXYKARBONSAREN]
J. B. Schaefer Jun. 1968 61 p In GERMAN
(KFK-765) Avail: CFSTI

The complex reaction of pentavalent Np and hexavalent U and Pu with acetic acid and α-hydroxycarboxylic acids (glycolic acid, lactic acid, α-hydroxybutyric acid, α-hydroxyvaleric acid, and α-hydroxycaproic acid) was investigated by spectrophotometric and potentiometric methods. The applicability of the spectrophotometric method was limited by the resolution of the spectrophotometer and the autoradiolysis and hydrolysis of the metal ions. The intensive absorption bands of Np(V) and Pu(VI), which for the free hydrated cations lie at 9804 and 8306 Å, are displaced in the complex compounds up to 100 Å toward the higher wave lengths. The concentration both of the free cations and the complex compound can be calculated from the pertinent absorption spectrum. The combination of both measurement data leads to the stability constants for the complex. Author (NSA)

N69-19645*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THEORY AND OPERATION OF A CARBON DIOXIDE REDUCTION UNIT WITH SABATIER REACTION
Lenwood G. Clark (M.S. Thesis—Va. Polytech. Inst.) May 1968 74 p refs
(NASA-TM-X-61519) Avail: CFSTI CSCL 07C

A carbon dioxide reduction unit was studied in which carbon dioxide and hydrogen are reacted via the Sabatier reaction to produce methane and water. The unit is part of the oxygen recovery subsystem of an integrated life support system. The study included an experimental investigation of the effects of feed-gas composition and flow rate, temperature, and pressure on reaction efficiency. Consideration is also given to the chemical equilibrium characteristics of the Sabatier reaction and an attempt is made to correlate experimental reactor performance with theory. Author

N69-19662# Junta de Energia Nuclear, Madrid (Spain).
DETERMINATION OF MEAN MOLECULAR WEIGHTS IN ORGANIC REACTOR COOLANTS. PART 3: DIFFERENTIAL CRYOSCOPY WITH THERMOELECTRIC THERMOMETER [DETERMINACION DE MASAS MOLECULARES MEDIAS EN REFRIGERANTES NUCLEARES ORGANICOS. PARTE 3: CRIOSCOPIA DIFERENCIAL CON TERMOMETRO TERMOELECTRICO]
E. Becerro and M. Carreira 1968 11 p refs In SPANISH; ENGLISH summary
(JEN-197-DQ/I-67) Avail: CFSTI

The solubility problems raised by some components of the polymeric residue of irradiated polyphenylic coolants, which make it necessary to operate with very small samples, have been solved by means of a differential cryoscopic technique using a thermoelectric thermometer (thermel) as sensitive element. The method is based on the direct measurement of the difference between the freezing points of the investigated solution and of a reference solution whose concentration may be changed at will. The change of $\Delta V(mV)$ versus c(molal) is linear, the equivalent point being determined either analytically or graphically depending on the required accuracy. The method has been tested by measurements on pure polyphenyls, using diphenyl ether as solvent. It has been also applied to the main prospective coolants for the DON reactor. Working with 10^{-2} molal solutions the accuracy is better than $\pm$ 2 per cent. Author (ESRO)

N69-19664# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
DIFFUSION AND KIRKENDALL EFFECT IN PLUTONIUM-ZIRCONIUM SYSTEM [DIFFUSION ET EFFECT KIRKENDALL DANS LE SYSTEME PLUTONIUM-ZIRCONIUM]
Clotilde Remy Oct. 1968 109 p refs In FRENCH; ENGLISH summary
(CEA-R-3573) Avail: CFSTI

Results are reported for the chemical diffusion in ϵ' B phase (bcc) over the range 10-70 atomic per cent plutonium. Concentration-penetration curves, obtained by using electron microprobe, have been analyzed by Hall and Matano methods. Chemical diffusion coefficients, measured from 650 to 900°C, increase with plutonium concentration and follow the Arrhenius law. Activation energies range from 18 up to 44K cal/mole for plutonium concentrations from 60 to 20 atomic per cent plutonium. Kirkendall effect was observed by the shift of inert markers located originally at the Zr-PuZr interface. The analysis of intrinsic diffusion coefficients variation, flux of the two species and lattice velocity was carried out by the incremental couples technique by using Darken and Heumann equations. It was found that D_{Pu} is greater than D_{Zr} their ratio increasing from 1 to 6 over the range 15-60 atomic per cent Pu. Activation energies for intrinsic diffusion coefficients vary between 25 and 50 K cal/Mole. Author (ESRO)

N69-19682# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
INFLUENCE OF DIFFUSION ON EXTRACTION KINETICS IN POROUS BODIES. THE CASE OF URANIUM OXIDES [INFLUENCE DE LA DIFFUSION SUR LA CINETIQUE D'EXTRACTION DANS UN CORPS POREUX. CAS DES OXYDES D'URANIUM]
Bernard Tinturier (Ph.D. Thesis--Paris Univ., 23 Dec. 1966) 1968 102 p refs In FRENCH; ENGLISH summary
(CEA-R-3514) Avail: CFSTI

The study of the leaching of heaped uranium ore can be considered theoretically as a problem of the diffusion of liquids in porous bodies and in particular its influence on the chemical reaction rates of conventional uranium oxides. Below a certain value of the pore diameter, diffusion is responsible for mass transfer. The porous structure can be characterized by various physical constants which modify the free diffusion equation and, as long as the pores have a diameter greater than a few microns, it can be shown that the pore walls have a negligible effect. The diffusion coefficients for the nitrate, sulfate, chloride, acetate and the perchlorate of uranium have been determined. In the case of the reaction of uranium trioxide with acids in a porous body, the reaction kinetics are governed by the arrival of the reagent by diffusion. The attack on uranium dioxide by an acid ferric iron solution has been studied under the same conditions and it has been found that the diffusion modifies the influence of the ferrous and ferric iron concentrations on the reaction kinetics. The same is true for the oxide U_3O_8. All the results concerning these reactions, studied in the absence of diffusion, should be modified to take this factor into account when it occurs in an extraction process. Author (ESRO)

N69-19710# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
VOLATILITY OF RUTHENIUM DURING VITRIFICATION OPERATIONS OF FISSION PRODUCTS. PART 2: FIXATION ON A STEEL TUBE, DECOMPOSITION OF THE PEROXIDE [VOLATILITE DU RUTHENIUM AU COURS DES OPERATIONS DE VITRIFICATION DES PRODUITS DE FISSION. DEUXIEME PARTIE: FIXATION SUR UN TUBE D'ACIER. DECOMPOSITION DU PEROXYDE]
Antonio Ortins de Bettencourt (Junta de Energia Nucl.) and Antoine Jouan Jan. 1969 53 p refs In FRENCH; ENGLISH summary
(CEA-R-3663-Pt-2) Avail: CFSTI

This report deals with a study of the thermal decomposition of ruthenium peroxide, RuO_4, and its deposition on steel tubing. After a brief bibliographic review of the various properties of this substance, a study is made, in the first part, of its deposition on a steel tube. In order to do this, a gas current containing RuO_4 marked with ^{106}Ru is passed through a stainless steel tube subjected to a temperature gradient which decreases in the direction of the gas flow. The temperature at which RuO_4 is deposited or is fixed on the tube is determined, and the influence of the flow rate is studied. In the second part, the kinetics of the decomposition of ruthenium peroxide into ruthenium dioxide is studied by introducing gaseous RuO_4 into a container placed in an electric oven, and following the reaction by γ counting. Author (ESRO)

N69-19740# Junta de Energia Nuclear, Madrid (Spain).
STUDY OF GRANITIC BIOTITES BY X-RAY FLUORESCENCE ANALYSIS: DETERMINATION OF IRON, MANGANESE, TITANIUM, CALCIUM, POTASSIUM, SILICON AND ALUMINUM [ESTUDIO DE BIOTITAS GRANITICAS POR FLUORESCENCIA DE RAYOS X: DETERMINACION DE HIERRO, MANGANESO, TITANIO, CALCIO, POTASIO, SILICIO Y ALUMINIO]
R. O. Toubes and J. Bermudez Polonio 1968 10 p refs In SPANISH; ENGLISH summary
(JEN-198-DQ/I-68) Avail: CFSTI

A method for the quantitative determination of iron, manganese, titanium, calcium, potassium, silicon, and aluminum, in granitic biotites is reported. Sample preparation is carried out by the minimum flux technique, and rubidium is used as internal standard for silicon and aluminum. Author (ESRO)

N69-19744 Michigan Univ., Ann Arbor.
POLARIZABILITY MEASUREMENTS OF THE ALKALI ATOMS SODIUM, POTASSIUM, RUBIDIUM AND CESIUM
William Davis Hall (Ph.D. Thesis) 1968 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-13321

The experimental determination was made of the electric dipole polarizabilities of the alkali atoms sodium, potassium, rubidium, and cesium. The measurements were made by observing the deflections of a collimated, velocity-selected atomic beam under the influence of an unhomogeneous electric field. The results are: $\alpha(Na) = (24.4 \pm 1.7) \times 10^{-24}$ cm^3, $\alpha(K) = (45.2 \pm 3.2) \times 10^{-24}$ cm^3, $\alpha(Rb) = (48.7 \pm 3.4) \times$ cm^3, and $\alpha(Cs) = (63.3 \pm 4.6) \times 10^{-24}$ cm^3. The alkali polarizabilities measured in this experiment were found to differ from previous experimental polarizability determinations in which beam velocity analysis was not available. Subsequent experiments measuring alkali velocity profiles and alkali polarizabilities as a function of argon scattering gas densities have demonstrated that the discrepancy in the polarizability values arises because of the velocity dependent scattering effect of the residual gas atoms which selectively removes low velocity atoms from the beam, thus distorting the assumed ideal modified Maxwellian velocity distribution. Dissert. Abstr.

N69-19777 Ohio State Univ., Columbus.
TENSILE STRENGTH OF LIQUID HELIUM
Kenneth Lee McCloud (Ph.D. Thesis) 1968 122 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-12855

The tensile strength of liquid helium was measured below the helium λ temperature under static conditions. Use was made of the helium fountain pressure to create the stress in the liquid. The values obtained for the tensile strength are larger than those found by ultrasonic cavitation methods, but smaller than those from the spinning capillary technique. The most striking feature is that helium does not have a well-defined tensile strength. Rather, with a constant applied stress, there is a statistical distribution of waiting times needed for rupture to occur. This distribution agrees very well with that expected from rupture due to events occurring randomly in time. The average waiting time $\langle\tau\rangle$ proved to be dependent upon the pressure in the liquid. The exact nature of the pressure dependence of $\langle\tau\rangle$ could not be determined due to the large inherent statistical error in each measurement of $\langle\tau\rangle$ and due to the existence of a time dependence of $\langle\tau\rangle$ at constant pressure. Dissert. Abstr.

N69-19778 Yale Univ., New Haven, Conn.
BEAM STUDIES OF THE ENERGY DEPENDENCE OF HOT HYDROGEN REACTIONS
Michael Adolph Menzinger (Ph.D. Thesis) 1968 190 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-13179

The energy dependence of high energy hydrogen atom reactions by means of beam methods was studied. For this purpose monoenergetic tritium ion beams of variable energy and narrow energy spread were generated. These were allowed to strike a solid target, for which cyclohexane was chosen as a prototype. The analysis of labelled products was carried out by gas chromatography in conjunction with internal flow-counting. A detailed description of the apparatus "ADAM" is given. The yields of labelled cyclohexane, n-hexane and hexenes from the reactions of T^+_2 with solid cyclohexane, and the yield of cyclohexane from the reaction of T^+ with solid cyclohexane were determined as a function of the beam energy (1-200 eV). For a comparison with the beam results, a series of specially designed recoil experiments were performed, during which tritons, generated by the $He^3(n,p)H^3$ reaction, were allowed to strike a cyclohexane film, which was frozen onto the walls of the irradiation vessel. Dissert. Abstr.

N69-19792*# Aztec School of Languages, Inc., Acton, Mass.
INVESTIGATION OF THE DISPERSED BITUMINOUS SUBSTANCE IN TEKTITES [ISSLEDOVANIYE DISPERSNOGO BITUMINOZNOGO VESHCHESTVA V TEKTITAKH]
G. G. Vorob'yev, I. A. Petersil'ye, and M. A. Pavlova Washington NASA Feb. 1969 6 p Transl. into ENGLISH from Meteoritika (Moscow), v. 28, 1968 p 85-88
(Contract NASw-1692)
(NASA-TT-F-12166) Avail: CFSTI CSCL 08G

Methods are described by which two separate groups of moldavite samples from various deposits in Czechoslovakia were analyzed. It was concluded that the bitumens of tektites were very similar to those of the naphthenes series, and tekites could very well be connected with volcanic or impact processes on the moon. Author

N69-19798 Wisconsin Univ., Adison.
ESR AND OPTICAL SPECTROSCOPIC STUDIES OF INTERMEDIATES FORMED IN THE γ-RADIOLYSIS OF SOLID ALKYL HALIDES AT 77°K
Richard James Egland (Ph.D. Thesis) 1968 275 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.55 Order No. 68-10905

One purpose of this thesis is to explain the anomalous ESR spectra observed in some γ-irradiated polycrystalline alkyl iodides, and to detect halogen-containing intermediates in γ-irradiated glassy and polycrystalline alkyl iodides, bromides, and chlorides. Information including the effects of isotopic labelling, is reported on the ESR spectra of irradiated polycrystalline n-alkyl iodides containing an even number of C atoms, prevously found to be different from the spectra in crystalline odd-C-numbered n-alkyl iodides. Dissert. Abstr.

N69-19840 Washington Univ., Seattle.
A THEORY OF CONDENSED BOSON SYSTEM AND ITS APPLICATION TO THE GAMMA-TRANSITION OF LIQUID HELIUM 4
Koo-Chul Lee (Ph.D. Thesis) 1967 158 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-9304

The Bogolubov procedure is used to generate an approximation scheme which is ultimately applied in the neighborhood of the phase transition line. This procedure is first shown to be mathematically correct in the thermodynamic limit by employing combinatorial analysis and saddle point techniques. The c-number replacement, which implies the use of the Hamiltonian function $H(\alpha_o)$ in the density matrix, thus does not require the original low temperature assumptions of Bogolubov. Temperature dependent Green's functions for the system are defined using the density matrix, and a perturbational approximation scheme for the Green's functions is developed. The theory of the lambda transition was developed based on simple properties of the four-point correlation function which follow from the approximation scheme developed for the self-energies and leads to a particular behavior of the number and energy fluctuations. These then provide expressions for the important thermodynamic derivatives, whose behavior is found to agree with previous investigations of the lambda transition in helium 4. It is noted that the approximation which yields these results for the phase transition will also give Beliaev's zero temperature results if some specified terms are neglected. Dissert. Abstr.

N69-19880*# Pittsburgh Univ., Pa. Space Research Coordination Center.
AN INTERFEROMETRIC STUDY OF DISSOCIATIVE RECOMBINATION RADIATION IN NEON AND ARGON AFTERGLOWS

Lothar Frommhold and Manfred A. Biondi 10 Feb. 1969 31 p refs
(Grant NsG-416; Contract Nonr-624(13)); Grant AF-AFOSR-766-67)
(NASA-CR-100358; SRCC-92; APP-22) Avail: CFSTI CSCL 07D

A photoelectric recording, pressure tuned Fabry–Perot interferometer of high resolution is used to determine the spectral line profiles of 22 neon and 5 argon ($2p_n \rightarrow 1s_m$) lines emitted from a microwave discharge and during the ensuing afterglow. All afterglow line profiles are broader than the corresponding discharge lines, and in most cases the afterglow line shapes are consistent with a dissociative origin of the excited atoms, indicating that the $2p_n$ excited states of neon and argon are produced by dissociative recombination of electrons with Ne_2^+ and Ar_2^+ ions, respectively. Detailed examination of the line profiles in neon indicates a multishouldered structure corresponding to several different dissociation kinetic energies, suggesting that different initial states of the Ne_2^+ ion are involved in the dissociative recombination process. From the deduced molecular ion energy levels it appears that, in addition to the Ne_2^+ ion state with a dissociation energy D = 1.35 eV reported by Connor and Biondi, there may be a more weakly bound state with D ≈ 0.5 eV which contributes to the recombination. Author

N69-19913 Case Western Reserve Univ., Cleveland, Ohio.
CATION SOLVATION IN LIQUID AMMONIA AS STUDIED BY PROTON MAGNETIC RESONANCE
Hang Hsin Lo (Ph.D. Thesis) 1967 83 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-10169

Proton relaxation by Ni(II) in liquid ammonia was investigated as a possible means for the extension of ion solvation studies into liquid ammonia. Anhydrous solutions of $Ni(NH_3)_6(ClO_4)_2$ in liquid ammonia were prepared, and the proton NMR spectra were recorded as a function of temperature. The line shapes were shown to be the result of spin–spin relaxation of the protons with no detectable contribution from spin–lattice relaxation of ^{14}N. Moreover, the temperature dependence of the proton T_2 revealed that the relaxation process is chemical exchange controlled below about 0° and that the relaxation mechanism is the chemical shift mechanism. Dissert. Abstr.

N69-19959 Pennsylvania State Univ., University Park.
THE ABSORPTION AND EMISSION SPECTRA OF CARBON DIOXIDE AT 4.3 MICRONS
Yu Hak Hahn (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-8700

The infrared absorption spectra of carbon dioxide have been measured with high resolution in the region from 2228 cm^{-1} to 2395 cm^{-1}. The measured bands are: five bands of $C^{12}O_2^{16}$, two bands of $C^{13}O_2^{16}$, one band of $C^{12}O^{16}O^{18}$, and one band of $C^{13}O^{16}O^{18}$. The band origins and molecular constants were calculated from the experimental data. The molecular constants ω^0_3, x^0_{33}, x^0_{13}, x^0_{23}, x_{33}, and y_{333} are derived from bands in the 00^0v_3–$00^0(v_3-1)$ sequence. A high-resolution spectroscopic study has been made of the emission in the 4.3 micron region of electrically excited CO_2–N_2 and CO_2–N_2–He laser plasmas. Most of the intensities of the CO_2–N_2 plasma derives from the fundamental and four "hot" bands of $C^{12}O_2^{16}$. With the mixture ratio and pressure carefully adjusted, the CO_2–N_2–He plasma emits lines of the 00^03–00^02 and 00^02–00^01 bands. Dissert. Abstr.

N69-19972# National Bureau of Standards, Washington, D. C.
STANDARD X-RAY DIFFRACTION POWDER PATTERNS
Howard E. Swanson, Howard F. McMurdie, Marlene C. Morris, and Eloise H. Evans Jun. 1968 92 p refs
(NBS-Monograph-25-Sect-6) Avail: SOD $0.60

Standard X-ray diffraction powder patterns are presented for 60 substances. Fifty-four of these patterns represent experimental data and 6 are calculated. The experimental X-ray powder diffraction patterns are made with a Geiger counter X-ray diffractometer, using samples of high purity. All d-values were assigned Miller indices determined by comparison with theoretical interplanar spacings and from consideration of space group extinctions. The densities and lattice constants were calculated, and the refractive indices were measured whenever possible. The calculated X-ray powder diffraction patterns were obtained from published crystal structure data. The reported peak height intensities for calculated patterns were converted from integrated intensities. Reference intensity values based upon the strongest line of corundum (113) in a 50 weight percent mixture are given for 98 materials. TAB

N69-19974# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Institut fuer Flugtreib- und Schmierstoeffe.
SYNTHESIS OF SELECTED POLYPHENYL ETHERS AND THEIR QUALIFICATION AS LUBRICATING OILS [UEBER DIE SYNTHESE AUSGEWAEHLTER POLYPHENYLAETHER UND DEREN EIGNUNG ALS SCHMIEROELE]
G. Spengler and M. Koll Dec. 1968 56 p refs In GERMAN; ENGLISH summary
(DVL-802; DLR-FB-68-86) Avail: CFSTI

Isomer mixtures of substituted polyphenyl ethers, unsubstituted and substituted polyphenyl ethers with side chains, polyphenyl ether esters and mixtures of substances with various lengths of chain and substitution were synthetized and their identification index and properties determined. Correlations between the chemical structure and the changes in pour points, in viscosity temperature behavior and in the thermal oxidation stability are discussed. In the case of unsubstituted and substituted polyphenyl ethers with side chains the wide temperature range between pour point and boiling point is remarkable. In connection with suitable additives these substances may become of interest for lubrication at high temperatures. Author

N69-20013# Brookhaven National Lab., Upton, N. Y.
THE DETERMINATION OF OXYGEN CONCENTRATION AND MASS TRANSFER COEFFICIENTS IN SODIUM USING URANIUM
H. S. Isaacs [1968] 21 p refs Supported by AEC
(BNL-13078) Avail: CFSTI

Experimental results and possible application of the use of uranium to determine oxygen concentrations in sodium are presented. Two electropolished uranium specimens were immersed in sodium for one-hour periods, and weight gains were recorded. After additions of sodium oxide, the weight gains increased in proportion to the amount of oxygen added. The oxygen concentrations were calculated by keeping an account of the weight of oxygen added to the sodium and removed by the uranium. Mass transfer coefficients of oxygen in sodium can also be determined by this method. NSA

N69-20018 Utah Univ., Salt Lake City.
LOW TEMPERATURE SHRINKAGE OF THORIA GEL. PART 1: KINETICS. PART 2: SHRINKAGE MODEL
Ru Kao Cheng (Ph.D. Thesis) 1968 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-12441

The rate of desorption of chemisorbed gases, primarily NO_2, H_2O, and CO_2, from pressed thoria gel pellets was measured by means of isothermal length decrease of the pellets as a function of time at various temperatures in the range 25 to 500°C. A kinetic equation based upon a fundamental model of the relationship between weight change and length change for an isotropic solid and employing an activation free energy dependent upon coverage of the surface by the chemisorbed gases was developed. Shrinkage

data for thoria gels of 0.15 and 0.20 NO_3/ThO_2 mole ratios showed a linear relation between normalized weight loss and shrinkage with almost the same value for the constant relating these two parameters found previously for gels of 0.1 NO_3ThO_2 ratio. Gas chromatographic analysis of the chemisorbed gases desorbed during shrinkage showed CO_2 NO_2, and H_2O decreasing in the order given. Dissert. Abstr.

N69-20044 Rensselaer Polytechnic Inst., Troy, N. Y.
ENERGY LEVEL STRUCTURE OF ZINC IN MAGNETIC FIELDS USING A SINGLE BAND EFFECTIVE HAMILTONIAN
Peter Sebastian Kapo (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-13520

The midplane of the second band in zinc is computed by means of the nearly free electron approximation. This band is Fourier analyzed and the coefficients, $a(\vec{R})$, are used to construct the magnetic effective Hamiltonian. This effective Hamiltonian is cast into the form of a matrix equation and the eigenvalue spectrum computed by numerical means for a range of magnetic fields. The eigenvalue spectrum found is compared with the Onsager rule and systematic deviations from the Onsager rule are noted. The fine structure of the magnetic bands is computed by a WKB method and these results are compared with the actual band structure. Certain deviations in the fine structure occur which can not be eliminated by further refinement of the WKB method, showing a failure of the WKB method in this respect. Dissert. Abstr.

N69-20116# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
EXCITATION OF THE SECOND POSITIVE SYSTEM OF MOLECULAR NITROGEN BY FAST ELECTRONS Final Report
Stuart L. Petrie (Ohio State Univ.) Jan. 1969 32 p refs
(CAL-AG-2258-A-1) Avail: Issuing Activity

The second positive emission system of molecular nitrogen was excited by electrons with energies near 10 keV. The excitation–emission analysis for direct excitation is presented and the observed distributions of rotational line intensities in the unresolved (0,2) band are interpreted in terms of the direct excitation process. Unresolved spectra were obtained in pure nitrogen over a static pressure range from 0.050 to 0.580 Torr. At pressures below 0.1 Torr, direct excitation by secondary electrons from the N_2 ($X^1\Sigma$) state was indicated. At pressures above 0.1 Torr, a combination of excitation processes and collisional de-excitation was indicated. Author

N69-20117# National Bureau of Standards, Washington, D. C. Spectrochemical Analysis Section.
ACTIVITIES OF THE NBS SPECTROCHEMICAL ANALYSIS SECTION, JULY 1967–JUNE 1968
Bourdon F. Scribner, ed. Sep. 1968 93 p refs
(NBS-TN-452) Avail: SOD $1.00

Research activities, improvement in equipment, and applications in analysis including the certification of standard reference materials are presented. In optical spectrometry studies were completed on the plasma torch as a means of excitation of solutions, and on computer programs for the calibration of photographic emulsions. In electron probe microanalysis a matrix scanner for automatic point-by-point grid scans was tested and a lithium-drifted silicon detector was installed for non-diffractive X-ray dispersion. A study was made of color composites for combining the information of three X-ray area scans. In quantitative probe analysis, measurements were made of X-ray mass attenuation coefficients, and a study of atomic number corrections is underway. Author

N69-20122 California Inst. of Tech., Pasadena.
PART 1: THE CRYSTAL STRUCTURE OF POTASSIUM BIS-(TRICYANOVINYL)AMINE. PART 2: NUCLEAR MAGNETIC RESONANCE STUDIES OF ALKALI HALIDE SOLUTIONS. PART 3: ELUCIDATION OF THE INTRAMOLECULAR HYDROGEN BOND IN ACETYLACETONE BY THE DEUTERIUM ISOTOPE EFFECT ON THE CHEMICAL SHIFT OF THE BRIDGE HYDROGEN
Leroy Chi-tsun Lin (Ph.D. Thesis) 1968 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-12749

Potassium bis-(tricyanovinyl)amine, $K^+N[C(CN)=C(CN)_2]_2^-$, crystallizes in the monoclinic system with the space group Cc and lattice constants, $a = 13.346 \pm 0.003$ Å, $b = 10.191 \pm 0.001$ Å, $c = 8.992 \pm 0.003$ Å, $\beta = 114.42 \pm 0.02°$, and $Z = 4$. Three dimensional intensity data were collected by layers perpendicular to b^* and c^* axes. The crystal structure was refined by the least squares method with anisotropic temperature factor to an R-value of 0.064. The nuclear magnetic resonance of ^{81}Br and ^{127}I in aqueous solutions were studied. An unusually large isotope effect on the bridge hydrogen chemical shift of the enol form of pentanedione-2,4 (acetylacetone) and 3-methylpentanedione-2,4 has been observed. Dissert. Abstr.

N69-20125 Harvard Univ., Cambridge, Mass.
ALKALI ATOM REACTIVE SCATTERING AND THE ELECTRON-JUMP MODEL
Roger Grice (Ph.D. Thesis) 1968 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-12909

The elastic and reactive scattering of K, Rb and Cs by Cl_2 is reported. The stripping behavior previously observed in reactions of alkali atoms with Br_2 and I_2 is again apparent. The reactive scattering distributions are found to be only weakly dependent on the alkali atom and more strongly dependent upon the halogen molecule. This effect is readily explained by the forces exerted during the dissociation of the halogen molecule ion in the electron jump model. A diminutive molecular beam velocity selector, for velocity analysis of reactive scattering has been constructed. This selector was employed in the velocity analysis of Cs + ICl scattering. The main peak of the reactive scattering has a similar recoil velocity to the elastic scattering; however a long tail also appears at high energy. A significant proportion of the velocity distribution at higher energies and at wide angles can be unequivocally identified as CsCl. Dissert. Abstr.

N69-20145# National Bureau of Standards, Washington, D. C. Organic Chemistry Section.
ORGANIC CHEMISTRY SECTION; SUMMARY OF ACTIVITIES JULY 1967–JUNE 1968
Robert Schaffer, ed. Sep. 1968 128 p refs
(NBS-TN-457) Avail: SOD $1.25

The reaction of sulfonic esters of D-mannitol with methoxide was examined; a new dianhydrohexitol was isolated and identified as 2,3:4,5 dianhydro-D-iditol. Methods for the esterification of tetrahydroxy-p-benzoquinone and benzenepentol, and the disproportionation of the former compound during acetylation were studied. A novel method for acylation in 100% phosphoric acid was developed. NMR spectroscopy was used to determine the conformations of several bi- and tri-cyclic carbohydrate derivatives in solution, and the influence of substituents and of dipolar interactions on conformation was analyzed. Extensive examinations of the properties of high-purity samples of creatinine, uric acid, and urea were made. The properties and methods for determining the purity of SRM cholesterol were studied. The oxidation of a variety of polycyclic, aromatic compounds by periodic acid was studied. A variety of methods were explored for assaying the water content in corn syrups. Author

N69-20154# Mound Lab., Miamisburg, Ohio.
ON THE DESIGN OF CLUSIUS–DICKEL THERMAL DIFFUSION COLUMNS
J. M. Saviron, F. G. Beltran, and D. Gonzalez 27 Nov. 1968 8 p refs Transl. into ENGLISH from Anales Fis. y Quim. (Madrid), Ser. A, no. 61, 1965 p 249–252 Prepared by Kresge–Hooker Sci. Library Serv.
(Contract AT(33-1)-GEN-53)
(MLM-1577(tr); Rept-19115b) Avail: CFSTI

The optimum separation pressures calculated for a thermal diffusion column from experimental measurements can be used for predicting the behavior of another column of different geometry and working temperatures for the same gas. Author (NSA)

N69-20168*# Aztec School of Languages, Inc., Acton, Mass.
STUDIES ON SALTS OF OXYTRIMETHYLENE-GLYCINE AND N-OXYMETHYL-GLYCINE [UNTERSUCHUNGEN UEBER SALZE DES OXYTRIMETHYLEN-GLYCINS UND DES N-OXYMETHYL-GLYCINS]
Hugo Krause Washington NASA Feb. 1969 13 p refs Transl. into ENGLISH from Chem. Ber. (Weinheim), v. 52B, 1919 p 1211–1222
(Contract NASw-1962)
(NASA-TT-F-11989) Avail: CFSTI CSCL 07C

Extensive studies were carried out on the conditions of formation of characteristic oxytrimethyleneglycine barium as well as on the representation of other N-oxymethylglycine salts. Author

N69-20170*# Techtran Corp., Glen Burnie, Md.
THE ABSORPTION SPECTRA OF OXYGEN UNDER HIGH PRESSURE AND THE EXISTENCE OF TETRA-ATOMIC OXYGEN MOLECULES. 1: ULTRAVIOLET BANDS BETWEEN 2900 AND 2300 A [UBER DIE ABSORPTIONSSPEKTREN DES HOCHKOMPRIMIERTEN SAUERSTOFFS UND DIE EXISTENZ VON O_4-MOLEKULEN. 1. DIE ULTRAVIOLETTEN BANDEN ZWISCHEN 2900 UND 2300 A]
W. Finkelnburg et al Washington NASA Mar. 1969 18 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 79, 1932 p 69–88
(Contract NASw-1695)
(NASA-TT-F-12108) Avail: CFSTI CSCL 07D

An instrument is described for studying absorption spectra at pressures up to 1000 Atm, and the absorption spectrum of compressed oxygen is studied as a function of pressure. A series of scattered triplate bands followed by a continuum is observed in the ultraviolet between 2900 and 2300 A which does not occur in oxygen at low pressure. The absorption of these bands increases as the square of the pressure; absorption by O_4 molecules by pairs of O_2 molecules in collision is involved. The source and significance of the band system, the convergence point of which corresponds to that of the O_2 ground state, are discussed in connection with the question of the existence of O^4. Author

N69-20200# Bristol Univ. (England). Dept. of Inorganic Chemistry.
ORGANOMETALLIC CHEMISTRY Final Scientific Report, 1 Sep. 1965–30 Sep. 1968
F. G. A. Stone Sep. 1968 22 p refs
(Contract AF 61(052)-847)
(AD-680814; AFOSR-69-0021TR) Avail: CFSTI CSCL 7/2

This report summarises studies in three main areas: (1) Fluorocarbon complexes of transition metals; (2) metal carbonyl complexes of the transition metals of the 4d and 5d series; (3) organoderivatives of silicon and tin. A summary and a bibliography of the 25 publications produced during the investigation forms the body of the Report. Among the main discoveries were new synthesis of rhodium and iridium carbonyls formation of fluorocarbon-metal complexes by oxidative-addition of d8 or d10 complexes, and the formation of new siloxanes from reactions between perfluoroketones and silthianes. Author (TAB)

N69-20233# Library of Congress, Washington, D. C. Aerospace Technology Div.
FERROELECTRICITY AND FERROELECTRIC MATERIALS Surveys of Foreign Scientific and Technical Literature
Jan. 1969 88 p refs
(AD-681289; ATD-68-15-72-2) Avail: CFSTI CSCL 20/3

The report reviews Soviet work on ferroelectricity and ferroelectric materials. The report is divided into six sections, according to main groups of ferroelectrics: Rochelle salt and related compounds; Tri-glycine sulfate (TGS) and related compounds; Potassium di-hydrogen phosphate (KDP) and isomorphous crystals; Barium titanate and other perovskite type oxides; Miscellaneous complex oxides and other materials; Methods and instruments. TAB

N69-20254# National Bureau of Standards, Washington, D. C. Analytical Coordination Chemistry Section.
SUMMARY OF ACTIVITIES JULY 1967 TO JUNE 1968
Oscar Menis, ed. Jul. 1968 92 p refs
(NBS-TN-454) Avail: SOD $0.55

Electrodeless discharge lamps, Xe-arc continuum sources, ac scanning systems, resonance detectors, and nebulizer-burner combinations were developed and tested for use in flame spectroscopy. Relative merits of flame emission, atomic absorption, and atomic fluorescence were evaluated. Specialized instrumentation was developed for use in thermal analysis and spectrofluorometry. An inert gas fusion apparatus with a unique sampling valve and gas flow system was constructed and coupled to a high-sensitivity gas chromatograph. A commercial inert gas fusion apparatus was tested and a vacuum fusion unit was modified for better successive determination of oxygen and nitrogen. The dissolution of refractory materials containing volatile or easily hydrolizable components was studied. Sealed Teflon-lined bombs were used for clay dissolution, and together with quartz tubes, for determining trace nitrides and antimony in steels and alloys. Formation and extraction of ternary complex systems were studied to enhance spectrophotometric and spectrofluorometric sensitivity for trace metal determination, and the use of microvolume techniques and chelating agents was tested. A large number of Standard Reference Materials and potential standards were certified for their major, minor, and trace constituents. K.W.

N69-20266# Ohio State Univ. Research Foundation, Columbus. Dept. of Chemistry.
PHYSICAL ORGANIC CHEMISTRY OF IMINES AND IMINIUM IONS Final Report, 1 Jul. 1965–30 Nov. 1968
Jack Hine 12 Dec. 1968 8 p refs
(Grant DA-ARO-D-31-124-G648)
(AD-680971; Rept-7) Avail: CFSTI CSCL 7/3

A summary is given of a study of structural effects on the stability of imines as shown by equilibrium constants for the formation of imines from isobutyraldehyde and primary amines. Also involved are studies of the kinetics of the reaction of isobutyraldehyde and methylamine and of the hydrolysis of the N-isobutylidene-methylamine formed in this reaction. Author (TAB)

N69-20267# Bureau of Mines, Reno, Nev. Metallurgy Research Center.
PHASE DIAGRAM FOR THE KF-YF SUB 3 SYSTEM
Bernard Porter, R. E. Meaker, and P. R. Bremner Mar. 1969 11 p refs
(BM-RI-7246) Avail: Issuing Activity

Differential thermal analysis measurements were used to characterize a phase diagram for the $KF–YF_3$ system at compositions between 0 and 60 mole-percent YF_3. A congruent melting point compound was observed at $3KF·YF_3$ which melts at 965°±5° C and undergoes solid-state decomposition at 725°±2° C. One peritectic and two eutectic compositions are also defined. Author

N69-20308# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FERROCENE-CONTAINING POLYMERS
25 Apr. 1968 21 p refs Transl. into ENGLISH from the book "Uspekhi v Oblasti Sintenza Elementoorganicheskikh Polimerov" Moscow, Nauka, 1966 p 212–223
(AD-681300; FTD-HT-23-306-68) Avail: CFSTI CSCL 7/3

The article surveys 53 works on ferrocene-containing polymers, the most recent of which were published in 1963. Carbon-chain polymers of the vinyl derivitives of ferrocene and hetero-chain ferrocene polymers are emphasized, with numerous chemical schematics. Author (TAB)

N69-20314# Aerospace Corp., El Segundo, Calif.
NANOSECOND PULSE RADIOLYSIS OF POLYSTYRENE AND POLY(METHYL METHACRYLATE)
Seymour Siegel Nov. 1968 43 p refs
(Contract F04701-68-C-0200)
(AD-680759; TR-0222(4250-20)-1; SAMSO-TR-68-473) Avail: CFSTI CSCL 7/5

Polystyrene and poly(methyl methacrylate) (PMMA) containing diphenyl and naphthalene as solutes have been studied by nanosecond pulse radiolysis. Solute negative ions were detected in PMMA but not in polystyrene. Solute triplet states were formed in times short compared with the lifetimes of the solute excited singlet states, whose presence was observed via their fluorescence. G(triplet) values for 0.2 M samples of naphthalene and diphenyl in polystyrene were estimated to be 1.7 and 1.3, respectively. It is also shown that for high concentrations of solute less than 25 percent of the solute triplet states is derived from ion neutralization inside the spur. No evidence of intersystem crossing from solute excited singlet states was observed. Triplet yields in PMMA were smaller than those in polystyrene by a factor of two or more and were strongly affected by other transient species accumulated inprevious irradiations. This latter quenching mechanism appears to involve the precursor, rather than the solute triplet states themselves. Possible modes of solute triplet state formations are discussed, and it is concluded that triplet energy transfer from the solvent is the most probable mechanism. Author (TAB)

N69-20317# California Univ., Santa Barbara. Dept. of Physics.
OPTICAL ABSORPTION MEASUREMENTS OF GROUND-STATE CN IN ACTIVE NITROGEN FLAMES
David T. Phillips, W. C. Walker, and H. P. Broida 6 Dec. 1968 9 p
(Contract Nonr-4222(01); ARPA Order 125)
(AD-681313; TR-28) Avail: CFSTI CSCL 7/4

Concentrations of CN in the X doublet Sigma, v 0 level as low as 10 to the ninth power molecules/cc have been detected in active nitrogen flames at pressures from 0.5 to 20 torr by optical absorption spectroscopy using a CN discharge light source and a refined ac detection method. A systematic study of CN absorption and emission intensity as a function of pressure and fuel has provided additional information about the mechanisms of formation and removal of ground-state CN in these systems. High-resolution measurements have revealed that the rotational population distribution in the ground vibrational level is thermal at pressures as low as 0.5 torr; this result is consistent with the estimated lifetime of ground-state CN in active nitrogen flames. Author (TAB)

N69-20322 Wisconsin Univ., Madison.
ABSTRACTION OF HYDROGEN AND CHLORINE ATOMS BY HOT AND THERMAL METHYL RADICALS PRODUCED FROM THE PHOTOLYSIS OF METHYL IODIDE IN THE GAS PHASE. PART 1. IDENTIFICATION OF ALKYL RADICALS PRODUCED BY IRRADIATION OF BRANCHED-ALKANE GLASSES AT 77 DEG K. PART 2.
Don Jordan Henderson (Ph.D. Thesis) 1968 274 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.55 Order No. 68-10913

Reactions of thermal methyl radicals with ethyl chloride were studied by photolyzing methyl iodide in the presence of ethyl chloride and a large excess of an inert moderating gas. The purpose was to determine the relative importance of chlorine and hydrogen atom abstraction. At 108°C, hydrogen atoms are abstracted at least 2,500 times more rapidly than chlorine atoms from ethyl chloride. The difference in activation energies of these two reactions, $E_{Cl} - E_H$, is estimated to be greater than 8 kcal mole^{-1}, assuming equal pre-exponential factors. Dissert. Abstr.

N69-20335 Purdue Univ., Lafayette, Ind.
CHEMICAL FOIBLES: PARAMAGNETIC CATALYSIS OF AND QUANTUM TUNNELLING IN CHEMICAL REACTIONS
Harris Horton Lloyd (Ph.D. Thesis) 1968 376 p
Avail: Univ. Microfilms: HC $17.10/Microfilm $4.90 Order No. 68-12582

The selenium-catalyzed isomerization of *cis*-stilbene was reinterpreted on the basis that the equilibria $1/4\ Se_8 \rightleftharpoons Se_2$ and Se_2 + *cis*-stilbene $\rightleftharpoons$ trans-stilbene + Se_2 are responsible for the reported kinetics between 200°C and 210°C. Available thermodynamic data for selenium can be extended to compute the thermodynamic properties of equilibrium at 200°C and 210°C. It was found the ΔH = 32 kcal/mole at both temperatures and that the equilibrium constant is 0.631×10^{-6} at 200° and 129×10^{-6} at 210°C. By combining the computed thermodynamic properties of equilibrium, the empirical reaction data for the isomerization of *cis*-stilbene catalyzed by hexagonal selenium, and the measured density of *cis*-stilbene at the reaction temperature, the Arrhenius equation for reaction was calculated to be $2.8 \times 10^5\ exp\ (-5.700/RT)\ M^{-1}\ sec^{-1}$ Dissert. Abstr.

N69-20336 Rensselaer Polytechnic Inst., Troy, N. Y.
THE QUANTUM MECHANICAL BASIS OF CHEMICAL KINETICS
Lawrence A. Mirarchi (Ph.D. Thesis) 1968 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-13524

Time-dependent perturbation theory is used to derive rate laws for a chemically reacting system from the time-dependent Schroedinger equation. Non-vanishing rates are obtained when the perturbation scheme is carried to second order. The derivation is applied to the case of transitions due to external forces (spectroscopic transitions), collisional energy transfer, and a simple chemical reaction. The results obtained for spectroscopic transitions are consistent with the traditional description although the more systematic derivation used here shows more explicitly that the transitions are second order rather than first order, as commonly assumed. A modified law of mass action with concentration dependent rate coefficients is obtained for collisional energy transfer and for the chemical case. The concentration dependence in the rate coefficients tends to increase the magnitude of the coefficients as the reaction progresses. It is pointed out that the general technique developed may be used, in principle, to deduce reaction mechanisms as well as rates. Dissert. Abstr.

N69-20357# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CHARGE ON ATOMS IN FERROCENE AND ITS ANALOGS

S. S. Batsanov Apr. 1968 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Sibirskoe (USSR), no. 8, 1962 p 110–113
(AD-681267; FTD-HT-23-248-68) Avail: CFSTI CSCL 7/4

From molecular orbital calculations and from previously published experimental data the positive charge of the metal atom and the distribution of negative charges on the rings are given for M(C5H5)2, where M is Mg, Ti, Sn, Pb, V, Nb, Ta, Cr, Mo, W, Mn, Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt; M(C5H5)3 where M is Al, Sc, Y, La, Ce, Pr, Nd, Sm, Gd, Dy, Er, Yb, U, As, Sb, Bi; M(C6H6)2 where M is V, Cr, Mo, W, Fe, Ni, Ru, Pd, Pt; M(C5H5)2Cl and M(C5H5)2NO3 where M is U, Ti, V, Cr, Mn, Fe, Co, Ni, Ru, Rh, Pd, Os, Ir, Pt. The data should make possible further calcn. of the strength of the metal-ring bonds. Author (TAB)

N69-20368# Aerospace Corp., El Segundo, Calif. Lab. Operations.
SHOCK TUBE STUDIES OF SULFUR HEXAFLUORIDE Research Report, Sep. 1967–Jun. 1968
Jerry F. Bott and Theodore A. Jacobs Oct. 1968 26 p refs
(Contract F04701-68-C-0200)
(AD-680790; TR-0200(4240-20)-4; SAMSO-TR-68-486) Avail: CFSTI CSCL 7/4

Shock tube kinetic studies of SF_6 dissociation have been made in the temperature range of 1650 to 2050K. Rate constants for the initial fragmentation of SF_6 have been determined and have been found to be explainable in terms of classical unimolecular reaction kinetics. The analysis of the data in terms of the RRK theory yielded the relevant unimolecular parameters, including the strength of the first S-F bond. Both IR and UV techniques were used to obtain the data. Author (TAB)

N69-20377# Michigan State Univ., East Lansing. Chemistry Dept.
INFRARED SPECTRA AND INTERNAL ROTATION IN PROPANE, ISOBUTANE AND NEOPENTANE
Samuel Weiss and George E. Leroi 1969 22 p refs
(Contract N00014-68-A-0109)
(AD-681081; TR-4(9)) Avail: CFSTI CSCL 7/4

The infrared spectra of propane, isobutane and neopentane were recorded at high path-length x pressure conditions between 200 and 800 inverse cm. A large number of combination bands were observed and assigned, and values for the torsional frequencies of isobutane and neopentane were derived from the combination bands. Potential barriers to internal rotation were calculated from the torsional frequencies and are compared with other results available from the literature. Author (TAB)

N69-20380# Bureau of Mines, Washington, D. C.
HELIUM: BIBLIOGRAPHY OF TECHNICAL AND SCIENTIFIC LITERATURE, 1 JANUARY 1947–1 JANUARY 1962
Harold W. Lipper, comp. and Carla W. Cherry, comp. 1968 530 p refs
(BM-IC-8373; Bull-484-Suppl) Avail: SOD $2.75

This bibliography lists 6827 titles. Articles of a general nature from trade journals and popular magazines are included to preserve comprehensive coverage of the subject. The chief objective of this bibliography is to collect in one place all of the known literature on helium. K.W.

N69-20390# New South Wales Univ., Kensington (Australia). Dept. of Nuclear and Radiation Chemistry.
RESEARCHES ON POSITRONIUM Final Report
James H. Green Nov. 1965 7 p
(Grant AF-AFOSR-62-398)
(AD-680818; AFOSR-69-0043TR) Avail: CFSTI CSCL 7/5

The results of research on the study of aqueous and liquid systems are given. Particular attention is directed to the formation of positronium compounds and to study the behavior of positronium in a system undergoing ionizing radiation. Equilibrium conditions for positronium compound formation in simple systems were also studied. Author (TAB)

N69-20401# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Chemistry and Chemical Engineering.
ESTIMATION OF RATE CONSTANTS DURING POLYPROPYLENE AUTOXIDATION
Leo Reich and S. S. Stivala Jun. 1968 13 p refs
(Contract N00014-68-A-0131)
(AD-681008; TR-3) Avail: CFSTI CSCL 7/4

Recently the rate constants for the autoxidation of isotactic polypropylene based upon a postulated relatively simple scheme were calculated. Electron spin resonance, volumetric and chemical techniques were employed. This paper demonstrates that similar values of these rate constants could also be calculated from a more general scheme. From this general scheme, expressions were derived which involved the rate constants of interest and other constants which had been previously calculated from experimental data based upon the use of infrared absorption techniques. The values of the calculated rate constants at various temperatures agreed well with those reported earlier where comparison was possible. Author (TAB)

N69-20410# Aerospace Corp., El Segundo, Calif. Lab. Operations.
OXIDATION RESISTANCE AND SEMICONDUCTIVITY OF A TUNGSTEN FLUORIDE OF LOW FLUORINE CONTENT
Bernard Siegel, Richard L. Johnson, and Paul Marx Nov. 1968 17 p refs
(Contract F04701-68-C-0200)
(AD-680767; TR-0200(4210-10)-7; SAMSO-TR-68-487) Avail: CFSTI CSCL 7/4

It is shown that at elevated temperatures, a tungsten fluoride of low fluorine content ($WF_{0.31}$) is considerably more resistant to oxidation than the pure metal. This is attributed to the electrostatic repulsion of attacking oxygen species by the fluoride bonds. Unlike gaseous fluorides, which require complete geometrical shielding of the central atom of each fluoride molecule for effective oxidation resistance, a relatively small ratio of fluorine-to-metal atoms suffices in the crystalline state. It is suggested that the fluorines in the crystalline compound must be situated in strategic sites, either by a complete screen of chemisorbed metal-fluorine bonds at the grain boundary surfaces, or by substitutional bonds in the lattice. The $WF_{0.31}$ compound is shown to be nonhomogeneous. Ten percent of the compound was an imperfectly crystalline tungsten monofluoride, which oxidized readily; the remaining 90 percent was $WF_{0.24}$, which is shown to be the oxidation-resistant component. It is also shown that $WF_{0.31}$ and an analogous group VI-A compound ($MoF_{0.47}$) are semiconductors, with specific conductivities at room temperature of 0.0000258 and 0.00000213 reciprocal ohm-cm, respectively. Both of these fluorides can be prepared by metal explosion reactions. Author (TAB)

N69-20411# Aerospace Corp., El Segundo, Calif. Lab. Operations.
OXIDATION OF SULFUR HEXAFLUORIDE
Bernard Siegel and Peter Breisacher Nov. 1968 22 p refs
(Contract F04701-68-C-0200)
(AD-680768; TR-0200(4210-10)-3; SAMSO-TR-68-472) Avail: CFSTI CSCL 7/2

Although SF_6 is extraordinarily inert toward oxygen, reaction can be initiated by the electrical explosion of extremely small masses of platinum into SF_6 - O_2 mixtures. It is shown that chemically trivial amounts of exploding metal can be effective initiators of the SF_6 oxidation. Under our experimental conditions, the major reaction forms SOF_4. Sulfuryl fluoride is a minor product, but thionyl fluoride is formed to a more significant extent. The data indicate that thionyl fluoride is formed by initial pyrolysis of SF_6

to SF4, followed by rapid oxidation of the latter. The extreme slowness of the SF6 oxidation is demonstrated by the very small conversion of electrical to chemical energy and by the fact that the observed products are far from equilibrium, despite the initial attainment of temperatures above 5000K in a significant volume of the reactants. In contrast, endothermic oxidations of SF4 with either O2 or NO2 are very fast. Extremely efficient conversion of electrical to chemical energy is obtained when small metal masses are exploded in these gaseous mixtures. The predominant product is always SOF2, but minor amounts of SOF4, SO2F2, SO2, and SF6 form to different extents when reaction parameters are varied. SF5Cl oxidation reactions are also fast by comparison to SF6 oxidation, and the predominant product of SF5-Cl oxidation initiated by metal explosions is likewise SOF2. TAB

N69-20412# Chicago Univ., Ill. James Franck Inst.
THEORETICAL AND EXPERIMENTAL STUDIES IN CHEMICAL PHYSICS Final Report
Stuart A. Rice 1968 19 p refs
(Grant AF-AFOSR-0781-67)
(AD-681168; AFOSR-69-0045TR) Avail: CFSTI CSCL 7/4

The paper provides abstracts for the 45 publications resulting from a two year study of the following: a theory of radiationless transitions in molecules; A theory of excitons in liquids and other disordered structures; Studies of the stationary states of molecular solids; and Studies in statistical mechanics concerned with the properties of liquids. TAB

N69-20420# George Washington Univ., Washington, D. C. Dept. of Chemistry.
THE THERMAL DECOMPOSITION OF ALKYL DIFLUORAMINO COMPOUNDS Final Report, Mar. 1966–Sep. 1968
Joseph B. Levy Dec. 1968 29 p refs
(Contract DA-18-001-AMC-980 (x))
(AD-680930; Rept-1) Avail: CFSTI

The preparation and purification of ethyl difluoramine are described. Pyrolysis experiments were performed with ethyl difluoramine from 300 to 462.5C using static and flow methods. The principal organic products were ethylene and acetonitrile. The reaction is first order. Evidence is presented to show that the reaction follows a molecular rather than chain mechanism. The reaction between nitric oxide and bistrifluoromethyl peroxide was found to be a bimolecular reaction yielding nitrosylfluoride and carbonyl fluoride. A mechanism is proposed which may be classified as a bimolecular radical elimination. Author (TAB)

N69-20425# Argonne National Lab., Ill.
SYNTHESIS AND INVESTIGATION OF PROPERTIES OF ISOTOPES OF TRANSURANIUM ELEMENTS [SINTEZ I ISSLEDOVANIE SVOISTV IZOTOPOV TRANSURANOVYKH ELEMENTOV]
G. N. Flerov et al Jun. 1968 14 p refs Trans. into ENGLISH from Russian Conf. Rept. JINR-D7-3548
(ANL-Trans-633) Avail: CFSTI

A brief review is given of the experimental research carried out at the Joint Institute for Nuclear Research during the period 1963 to 1966. The development of the cyclotron and other auxiliary detection equipment is discussed. Alpha-decay data on isotopes from einsteinium to lawrencium are tabulated. The controversy over the synthesis and identification of element 102 is also discussed. The synthesis and identification of element 104 is described, and it is indicated that the reactions $^{243}Am(^{22}Ne,4n)$ and $^{243}Am(^{22}Ne,5n)$ will be used in future attempts to synthesize element 105. NSA

N69-20434# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN RESULTS OF DETERMINING INDIVIDUAL COMPOSITION OF GASOLINE FRACTIONS BY THE METHOD OF GAS–LIQUID CHROMATOGRAPHY
E. K. Bryanskaya et al 7 Jun. 1968 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Neft i Gaz (Baku), no. 6, 1966 p 45–48
(AD-681265; FTD-HT-23-76-68) Avail: CFSTI CSCL 21/4

A gas chromatograph equipped with a 70 m., 0.25 mm. i.d. capillary column coated with squalene and an ionization dector was used to determine 37 of the possible 38 hydrocarbons in the straight run 111C gasoline fractions of 5 Soviet crudes. For the C7-isoparaffins the following ratios were obtained for all crudes: 3-methylhexane and 3-ethylpentane (90:10); 2,3-dimethylpentane and 2,4-dimethylpentane (80:20); and 3,3-dimethylpentane and 2,2-dimethylpentane (50:50). For the C7-cycloparaffins the ratio of cis- to trans-1, 3-dimethycyclopentane is (53:47) and for cis- to trans-1, 2-dimethylcyclopentane it is (12:88). These ratios correspond to the thermodynamic equilibrium at 600K. Author (TAB)

N69-20494# Michigan State Univ., East Lansing. Chemistry Dept.
RAMAN STUDIES OF MOLECULAR MOTION IN CONDENSED OXYGEN
J. E. Cahill and G. E. Leroi Dec. 1968 35 p refs
(Contract N00014-68-A-0109)
(AD-681080; TR-9(34)) Avail: CFSTI CSCL 7/4

Raman scattering has been observed from both the external and internal motions of the molecules in each of the four condensed phases of oxygen. The stretching vibration gives rise to a sharp band at 1552.5/cm in each phase. Weak wings occur at the base of this band in the gamma and liquid phases. Vibrational lattice modes are obeserved at 44 and 79/cm in the alpha phase and at 50/cm in the beta-phase. The intensities of these bands relative to that of the internal fundamental are in reasonable agreement with those expected from the oriented gas model. In gamma and liquid oxygen, the external motion gives rise to strong wings on the Rayleigh line. Estimates of the mean square torsional amplitude and the torque acting on the molecule have been made from the observed low frequency spectra, and indicate that the torsional motion is highly hindered in each phase. The root mean square torsional amplitude increases from an average of 9 deg. in the alpha phase to 18 deg. in the liquid. Author (TAB)

N69-20497# Stanford Univ., Calif. Center for Materials Research.
MATERIALS RESEARCH AT STANFORD UNIVERSITY Annual Report, 1 Jul. 1967–30 Jun. 1968
Dec. 1968 310 p refs
(Contract ARPA SD-87)
(AD-681053; AR-7) Avail: CFSTI CSCL 11/7

The report contains brief descriptions of the various individual research programs active during the period July 1967 through June 1968, arranged alphabetically by the name of the principal investigator. Also included are lists of publications, doctoral dissertations, faculty and senior staff members, research associates, graduate students and degrees awarded. Finally, a name index is included for convenience in locating references to the activities of specific individuals. Author (TAB)

N69-20501# IIT Research Inst., Chicago, Ill. Dept. of Metallurgical Engineering.
A HIGH PURITY REACTION GAS SYSTEM FOR FIELD EMISSION AND IONIZATION MICROSCOPES
Conrad J. Polk Jan. 1969 17 p refs
(Contract Nonr-1406(10))
(AD-681089; TR-1) Avail: CFSTI CSCL 7/4

A reaction gas system capable of supplying high purity oxygen in the form of a molecular beam to a combined field ion-emission microscope is described. Gas pressure at the emitter could be continuously varied from .001 to 0.000000001 torr. The construction, operation, and calibration of the system are discussed. Also included is a brief discussion of an interrupted time sequence technique used to study oxidation reactions at temperatures from 30 to 900C. Author (TAB)

N69-20502# Systems Research Labs., Inc., Dayton, Ohio.
RELATIONS BETWEEN POINT DEFECTS IN THE COMPOUND M_2X_3 Interim Report
R. W. Vest, W. C. Tripp, N. M. Tallan, and H. C. Graham
Wright-Patterson AFB, Ohio ARL Oct. 1968 216 p refs
(Contract AF 33(657)-10815)
(AD-680835; SRL-TR-680-F; ARL-68-0187) Avail: CFSTI CSCL 20/2

The results of a computer study of the mass action equations as used for the formation of point defects in binary compounds are presented. The results are in easily read tabular form from which a neutrality condition can be deduced for a particular predominant defect. The pressure dependence and the equilibrium constants involved in the formation of each defect are listed. Author (TAB)

N69-20513# National Bureau of Standards, Washington, D. C.
CRITICALLY EVALUATED TRANSITION PROBABILITIES FOR Ba I AND II
B. M. Miles and W. L. Wiese Jan. 1969 27 p refs
(AD-651351; NBS-TN-474) Avail: CFSTI SOD $0.30 CSCL 7/4

Critically evaluated transition probabilities, in order of increasing quantum numbers, are compiled for Ba I and II from available literature sources. Author (TAB)

N69-20515# Michigan State Univ., East Lansing. Dept. of Chemistry.
RAMAN SPECTRA OF SOLID CARBON DIOXIDE, NITROUS OXIDE, NITROGEN GAS AND CARBON MONOXIDE
J. E. Cahill (Princeton Univ., N. J.) and G. E. Leroi (Princeton Univ., N. J.) Jan. 1969 32 p refs
(Contract N00014-68-A-0109)
(AD-681370; TR-5(10)) Avail: CFSTI CSCL 7/4

The Raman spectra of solid CO2, N2O, N2, and CO have been observed. Each spectrum can be analyzed by assuming an approximately ordered structure isomorphous with that of CO2. The lattice mode intensities have been calculated on the basis of the oriented gas model; they are in good agreement with the measured values, and lead to confident assignments of the observed bands. The peak frequencies of these bands decrease an average of 15% on warming from 15K to the phase transition and there is a considerable concommitant increase in their widths. Author (TAB)

N69-20525# Avco-Everett Research Lab., Everett, Mass.
WAKE TEMPERATURE TURBULENT FLUCTUATION DECAY RATES DEDUCED FROM OXYGEN RADIATION
George W. Sutton and Morton Camac Oct. 1968 52 p refs Submitted for publication
(Contract F04701-68-C-0036)
(AD-681154; AERL-RR-297; SAMSO-TR-68-365) Avail: CFSTI CSCL 20/4

The effects of temperature fluctuations in a hypersonic turbulent wake on a chemical reaction with a strong temperature dependence are examined to determine the appropriate turbulence parameters for several different turbulent wake models. The chemical reaction selected for its temperature sensitivity is the atomic oxygen chemiluminescent recombination. The wake turbulence models employed in this analysis are: (1) Random inviscid convection (so-called marble cake); (2) Homogeneous mixing; (3) Partial dissipation or bimodal model; (4) Mixing lag models; (5) Gaussian mean temperature profile with superimposed fluctuations. The data are interpreted in terms of each model. It is shown that models 1, 2 and 4 are inconsistent with the data. The radiation is interpreted in terms of the unmixed volume fraction of the partial dissipation model, to obtain the rms turbulent temperature and mass density fluctuations and the turbulent dissipation function, which is then applied to predict the rms fluctuations of electron density. It is found that the resulting predictions are consistent with other measurements. The dissipation function indicates that the mixing lag length is equal to about 20 wake radii. The model involving the gaussian mean temperature profile and fluctuations is consistent with the data for a thermal half width equal to slightly less than half the mean turbulent front wake radius, with the temperature fluctuation ratio on the axis between 0.3 and 0.5. This is consistent with the measured mean temperature profiles and temperature fluctuations, but the results are very sensitive to the mean temperature in the wake. Author (TAB)

N69-20526# Technische Hogeschool, Eindhoven (Netherlands).
THE STUDY OF DESTRUCTIVE HYDROGENATION OF NAFTALENE, PHENANTRENE, AND ANTRACENE [EEN STUDIE OVER DE DESTRUCTIEVE HYDROGENERING VAN NAFTALEEN, PHENANTREEN, ANTRACEEN]
Johannes Mathieu Leonardus Penninger (Ph.D. Thesis) 17 Dec. 1968 117 p refs In DUTCH; ENGLISH summary
Avail: CFSTI

A description is given of the development of an experimental technique for the study of destructive hydrogenation of oil-fractions at elevated temperatures and pressures. The principle technique was the application of G.L.C. The cracking of naftalene, phenantrene and antracene has been examined; of special interest was the cracking of 1,2,3,4-tetrahydronaftalene. From the experimental results, it is derived that cracking of naftalene in hydrogen occurs via the intermediate tetraline. Hydrogen is also necessary for futher degradations of tetraline. Primary cracking products from tetraline are: n-butylbenzene, 1-methylindane and styrene. With the concepts derived from the cracking of tetraline, the cracking of phenantrene and antracene can be explained. Author

N69-20542# Purdue Univ., Lafayette, Ind.
MATERIALS SCIENCE RESEARCH Progress Report, 1 Oct. 1967-30 Sep. 1968
Dec. 1968 175 p refs
(ARPA Order SD-102)
(AD-681025; PR-7) Avail: CFSTI CSCL 11/7

Summaries of various materials research projects are presented. Categories include: (1) analytical studies, (2) band structure and excitations, (3) imperfections, (4) kinetics, (5) mechanical properties, (6) molecular studies, (7) thermophysical properties, and (8) transport properties. F.O.S.

N69-20556 Michigan Univ., Ann Arbor.
EFFECT OF VIBRATION OF THE ELECTROCHEMICAL KINETICS AT A NICKEL ELECTRODE
Alfred Ellis Hoover (Ph.D. Thesis) 1968 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-13332

The purpose of this investigation was to study a multiple electrode process through the changes in potential under varying conditions of current density as the electrode is vibrated by an electrodynamic driver. The study was carried out on solutions which were molar with respect to nickel chloride, 0.26 molar orthoboric acid, at pH's of 1.26, 2.52, 3.96, and molar with respect to hydrochloric acid. The study showed that an electromechanically driven vibrator offers a simple, effective means of agitating a

working electrode. A design was given for an electrode assembly for the measurement of polarization potentials by means of a capillary located at the working surface of a moving electrode, thus eliminating the problems of screening of the electrode by the capillary and varying solution resistance between the capillary and the vibrating electrode. The study showed that longitudinal vibration of an electrode changes the polarization of a multiple electrode involving both hydrogen and nickel, generally decreasing the polarization. Dissert. Abstr.

N69-20598# Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon (France).
QUANTITATIVE DETERMINATION OF TRACES OF SODIUM AND POTASSIUM IN NITROGEN TETROXIDE AND IN ASYMMETRIC DIMETHYLHYDRAZINE [DOSAGE DES ALCALINS SODIUM ET POTASSIUM DANS LE PEROXYDE D'AZOTE ET LA DIMETHYL HYDRAZINE DISSYMETRIQUE]
M. Soulivet 18 Jun. 1968 11 p In FRENCH
(Contract ELDO-CTR-17/3/15)
(LRBA-CR-71/68/EP) Avail: CFSTI

This note deals with quantitative determination of trace alkali metals (i.e. sodium and potassium) in nitrogen tetroxide and asymmetric dimethylhydrazine by flame spectrophotometry. This investigation relates to a study of radio wave attenuation caused by jet plumes during first and second stage separation of the ELDO launch vehicle. ESRO

N69-20602# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Chemistry and Chemical Engineering.
MOLECULAR-WEIGHT CHANGES DURING AUTOXIDATION OF ATACTIC POLYPROPYLENE IN SOLUTION
Leo Reich and S. S. Stivala (Picatinny Arsenal) 7 Aug. 1968 11 p refs
(Contract N00014-68-A-0131)
(AD-681050; TR-2) Avail: CFSTI CSCL 7/4

Expressions previously reported for changes in intrinsic viscosity as a function of time during the autoxidation of atactic polybutene-1 in the bulk phase were applied to the data provided by Bawn and Chaudhri for the autoxidation of atactic polypropylene in solution. The quantitative evidence obtained indicates that the intrinsic viscosity relationships which were found to be valid for the autoxidation of APB in the bulk phase are also valid for the autoxidation of APP in solution (at polymer concentrations of ca. 1.5 M and above). TAB

N69-20604# Case Western Reserve Univ., Cleveland, Ohio. Ultrasonics Research Lab.
ULTRASONIC VIBRATION POTENTIALS AND MICELLE FORMATION
Raoul Zana and Ernest Yeager Sep. 1968 20 p refs
(Contract Nonr-1439(04))
(AD-681063; TR-34) Avail: CFSTI CSCL 7/4

Ultrasonic vibration potential measurements have been made in solutions of salts exhibiting micelle formation. Specific systems studied have included sodium lauryl sulfate (NaLS) and laurylpyridinium bromide (LPB) and iodide (LPI). The apparatus and techniques are similar to those used in earlier contract research. These studies indicate the following: (1) Experimental data for ionic vibration potentials in dilute solutions of NaLS at concentrations far below the critical micelle concentration agree well with theoretical values; (2) The concentration dependence of the vibration potentials in solutions of NaLS, LPBr and LPI at concentrations below the critical micelle concentration provides strong evidence for the formation of charged aggregates which are precursers to micelle formation; (3) In favorable situations, ultrasonic vibration potentials can be used to recognize the critical micelle concentration. TAB

N69-20619# Akron Univ., Ohio. Dept. of Chemistry.
SEMIEMPIRICAL MOLECULAR ORBITAL CALCULATIONS ON BORANES 1—ARYLBORONIC ACIDS OR ESTERS
Terminal Report, Sep. 1966–Sep. 1968
Brian G. Ramsey and Hirotoshi Ito Sep. 1968 29 p refs
(Contract N00014-67-A-0116)
(AD-681364; TR-3) Avail: CFSTI CSCL 7/4

Traditional Pariser-Parr-Pople and variable electronegativity calculations have been carried out on C6H5B(OR)2 and p-CH3OC6H4B(OR)2, and the results compared with calculations for C6H5BR2. It is concluded that the VESCF method offers a real advantage over the simple PPP method for predicting percent charge transfer and transition intensity in cases where excited states possess substantial C.T. character. The restriction that empirically chosen parameters fit the observed transition energies and intensities of both triarylboranes and ArB(OR)2 requires the choice of a boron VSIP greater than 2.0 ev in the fixed parameter procedure of the usual PPP-SCF-CI method for these molecules. Observed transitions in C6H5B(OR)2 correlate with 1Lb, 1La, 1Bb, whereas the first absorption maximum of (C6H5)3B is assigned to C.T. (1A1 to 1A1) local C2v symmetry. Author (TAB)

N69-20684# Nuklearni Institut Josef Stefan, Ljubljana (Yugoslavia).
THE UTILIZATION OF SULFUR HEXAFLUORIDE FOR DELTA S 34 REQUIREMENTS [DIE ANWENDUNG DES SULFUR HEXAFLUORIDE FUER DELTA S 34 BESTIMMUNGEN]
H. Leskovsek, J. Marsel, and J. Slivnik Sep. 1968 9 p refs In GERMAN
(NIJS-R-539) Avail: CFSTI

A new method for the chemical preparation of samples of the mineral sulfides in SF_6 for the determination of δ S 34 is described. The samples are converted to SF_6 by fluorination with elementary fluorine at a temperature of 150° C and at a pressure of 5 atm. Due to the chemical and physical characteristics of the SF_6, the purification of the product is relatively simple. Mass spectrometric measurements with SF_6 are also simpler than those with SO_2 because of the higher mass range, lower memory effect, and the presence of monoisotopic fluorine. Several sample values of δ S 34 measured with SF_6 and with SO_2 are presented. Transl. by K.W.

N69-20700# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Chemistry and Chemical Engineering.
ISOMERIC AND SUBSTITUENT EFFECTS IN SOME DIBENZOYLBENZENE-DIAMINE POLYMERS
A. A. Volpe, L. G. Kaufman, and R. G. Dondero Oct. 1968 21 p refs
(Contract N00014-68-A-0131)
(AD-681363; TR-5) Avail: CFSTI CSCL 7/3

An investigation was undertaken to determine the properties of a series of polymers based upon various aromatic diamines and several isomeric diketones. Consequently, six isomeric polymers were synthesized by the acid catalyzed polycondensation of p- and m-dibenzoylbenzene with o-, p-, and m-phenylenediamine. Two fluorine containing, isomeric polymers were also synthesized by condensing m-dibenzoylbenzene with tetrafluoro-m-phenylenediamine and tetrafluoro-p-phenylenediamine. Comparative thermal stabilities of the products both in air and under a nitrogen atmosphere were investigated by thermogravimetric analysis. Several of the polymers exhibited a high degree of thermal stability and all of the polymers exhibited essentially the same resistance to initial thermal decomposition in the oxidative as well as the non-oxidative atmosphere. A correlation of molecular structure and geometry with thermal stability and solubility is discussed and a mechanism for initial thermal decomposition of some of the polymers is proposed. Author (TAB)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N69-19622*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A QUANTUM MODEL OF COMMUNICATION SYSTEMS
Melvin D. Aldridge (Ph.D. Thesis—Va. Univ.) Jun. 1968 108 p refs
(NASA-TM-X-61522) Avail: CFSTI CSCL 17B

The problem of including quantum effects within existing methods of communication system analysis is investigated. A mathematical model is postulated for describing narrow bandwidth systems. Utilizing the Glauber P representation, the model permits analysis of both real field detection (measurement of electric and magnetic field magnitudes) and photon detection. The resulting equation which describes photon detection is shown to be consistent with previous work which has been proven experimentally. Unique aspects of the postulated model are its ability to describe both random and deterministic modulation functions in conventional terms, and its ability to demonstrate the inapplicability of the "photon channel" model for describing present-day systems. Author

N69-19624*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A FEASIBILITY STUDY OF AN ADAPTIVE BINARY DETECTOR
Miles Melvin Bruce (Ph.D. Thesis—Va. Univ.) Aug. 1968 105 p refs
(NASA-TM-X-61467) Avail: CFSTI CSCL 17B

A system which is capable of acting as an adaptive binary detector is proposed and analyzed. Exponential smoothing is used for estimation of the mean. A technique similar to exponential smoothing is used for estimation of the variance. The system uses the frame synchronization code as a teacher in order to adapt itself to the characteristics of the environment. Decision Directed Measurements are used when the frame synchronization code is not available. The speed and accuracy of the different techniques are derived. The optimum location of the initial conditions of the system is also determined. Author

N69-19656# Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon (France).
ATTENUATION MEASUREMENTS OF HYPERFREQUENCY WAVES ACROSS THE SEPARATION EXHAUST JET FOR FIRST AND SECOND STAGES OF EUROPA I LAUNCH VEHICLE [MESURES D'ATTENUATION D'ONDES HYPERFREQUENCES AU TRAVERS DU JET DU PROPULSEUR DE SEPARATION 1ER–2EME ETAGE DE L'ENGIN EUROPA]
Gilles Raymond 11 Mar. 1968 27 p In FRENCH
(Contract ELDO-CTR-17/3/15)
(LRBA-E.1311-PV-3/EAS) Avail: CFSTI

This note comprises the results of hyperfrequency wave attenuation measurements of the first and second stage separation engine of the Europa 1 launch vehicle. Hyperfrequency waves of 3 and 5 cm wavelength are tested at 110 mm from the exit plane of the nozzle. Conclusions are drawn on the electric state of the plasma formed by the jet flame. ESRO

N69-19678# Selenia S.P.A., Rome (Italy).
ELDO INITIAL PROGRAM: F7 MULTISTAGE VEHICLE. RADIO FREQUENCY INTERFERENCE THEORETICAL STUDY. ASSEMBLED VEHICLE ON ITS OWN
Paris ELDO 29 Oct. 1968 205 p
(ELDO-RFI-14) Avail: CFSTI

All possible interference among various onboard R.F. equipment for the F-7 flight configuration of the ELDO launch vehicle is examined. The main radio frequency characteristics of the ELDO vehicle are recalled and the operating and spurious frequencies of transmitters along with the receiver characteristics are analyzed. Path attenuations between possible interfering transmitters and receivers are investigated in order to ascertain preventive and corrective actions to be undertaken to avoid receiver desensitization. A short mention is made of the Stevenage tests in order to confirm the validity of the theoretical results with those practically obtained through simulated measurements. Author (ESRO)

N69-19701# Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon (France).
ELECTROMAGNETIC WAVE ATTENUATION DURING FLIGHT BY THE PLUME OF CORALIE [ATTENUATION EN VOL DES ONDES ELECTROMAGNETIQUES DANS LES JETS DE CORALIE]
I. C. Amoury 1 Apr. 1968 40 p refs In FRENCH
(Contract ELDO-CTR-17/3/15)
(LRBA-NT-E.1311-NT-3/EAS) Avail: CFSTI

Reports the results of the calculations of electromagnetic wave attenuation (150 and 250 MHz) through the jet plumes of the second stage of Europa 1 launch vehicle at altitudes of 60, 80 and 120 km. ESRO

N69-19704# Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon (France).
ELECTROMAGNETIC WAVE ATTENUATION IN THE JET EXHAUST OF CORALIE. INTERACTION OF FOUR ENGINES [ATTENUATION DES ONDES ELECTROMAGNETIQUES DANS LES FLAMMES DE CORALIE. INTERACTION DES QUATRE MOTEURS]
D. Bahural and F. Kauba 1 Apr. 1968 38 p refs In FRENCH
(Contract ELDO-CTR-17/3/15)
(LRBA-NT-E.1311-NT.5/EAS) Avail: CFSTI

The interaction between the four jets of CORALIE produces shock waves which influence the radio wave attenuation. In order to evaluate the corrections due to this factor, a vacuum chamber study is made on a compressed-air model of CORALIE, which allows to visualize the structure of the jets at 60 and 70 km altitude. The corrections, depending on the angle of propagation with the axis of the nozzle, seem relatively small. The present simulation still only allows to determine the modification of the internal structure of the jet flow. ESRO

N69-19741# Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon (France).
ATTENUATION OF ELECTRO-MAGNETIC WAVES DURING THE SEPARATION OF THE FIRST TWO STAGES OF THE EUROPA VEHICLE
M. Amaury Paris ELDO 12 Apr. 1968 41 p
(Contract ELDO-CTR/17/3/15)
(ELDO-TR-4; ELDO-LRBA-TN-E.1311-NT4/EAS) Avail: CFSTI

This report consists of two technical notes. The first note presents the results of calculations of the attenuation of electro-magnetic waves in the frequency band 150 to 250 MHz due to the passage through the jet created by the solid propellant motor used in the separation of the first two stages of the EUROPA I vehicle. The second note reviews the studies carried out on the problems of attenuation of electromagnetic waves in the exhaust of the 2nd stage (CORALIE) engines. In particular it gives an account of the attenuations to be expected during flight of the vehicle. Author (ESRO)

N69-19779 Purdue Univ., Lafayette, Ind.
DIGITAL COMMUNICATION SYSTEMS SUBJECT TO FREQUENCY SELECTIVE FADING
Charles Carter Bailey (Ph.D. Thesis) 1968 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-12519

The effects of frequency selective fading on binary digital communication systems and a method of alleviating some of these effects are studied. The frequency selective fading is assumed to be describable in terms of a filter whose transfer function is a sample function from a complex Gaussian random process. Matched filter detection at the receiver is assumed to be employed. Although the analytical methods used are general, DPSK signaling is assumed for all the quantitative results. In order to determine the probability of error for this system, a technique due to Bello and Nelin is used. This is applied to three cases: (1) square pulse signaling and Gaussian-function-shaped channel frequency correlation function; (2) square pulse signaling and sin(x)/x-shaped channel frequency correlation function; and (3) raised cosine signaling and sin(x)/x-shaped channel frequency correlation function.
Dissert. Abstr.

N69-19855 Ohio State Univ., Columbus.
ON THE APPLICATION OF THE POINT MATCHING TECHNIQUE TO ANTENNA AND SCATTERING PROBLEMS
Gary Allen Thiele (Ph.D. Thesis) 1968 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-12878

The point matching or linear equation technique is applied to two antenna problems and one scattering problem. First, the point matching method is applied to the classical problem of calculating the current distribution on a thin linear antenna or dipole. This technique is then carried further in solving a second problem; namely, that of the Yagi-Uda array. In this array the dipole serves as the exciting element and the parasitic elements are treated as scatterers. The computer program written for this problem calculates the far-field patterns as well as the amplitude and phase of the currents on every element in the array. Also shown is how the phase velocity along the array affects the far-field patterns. A new method of calculating the impedance of the Yagi-Uda antenna is also discussed. The third problem to be considered is that of scattering by an imperfectly conducting wire. The problem is formulated as an integral equation which accounts for the finite conductivity in a rigorous manner. Results are presented that show clearly the effect of conductivity on the echo area.
Dissert. Abstr.

N69-19863# Federal Aviation Administration, Washington, D. C.
TIMING POTENTIAL OF LORAN-C/D
Bernard Wieder *In its* Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 51–55 (See N69-19856 09-14)
Avail: Issuing Activity

Precise navigation using the Loran C/D system utilizes the predictability and repeatability of the phase of the signal at the location of the slave clock for time synchronization of remotely located clocks. For absolute time calibration, the delay of the signal through the equipment must be known; for repeatability, this delay must be maintained to close tolerance. Portable cesium clocks are recommended for initial calibration of remote clocks of timing systems in which the slave clocks have a high stability so that infrequent readjustments are required.
G.G.

N69-19866# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
TIME DISSEMINATION BY SATELLITE
G. C. Weiffenbach *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 85–88 (See N69-19856 09-14)
Avail: Issuing Activity

The use of rubidium vapor frequency standards in satellites and a higher modulating frequency for the time markers are recommended to improve the timing accuracy of a collision avoidance systems that utilizes a four satellite system in 600 nm orbits. Raising the modulation frequency will increase the resolution of each time measurement and the rubidium standard will give a more accurate clock rate because its drift can be predicted 24 hours ahead to an accuracy of a few parts in 10^{13}.
G.G.

N69-19868*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON NASA SATELLITE TRACKING AND DATA ACQUISITION NETWORK (STADAN)
M. E. Shawe *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 95 (See N69-19856 09-14)
Avail: Issuing Activity CSCL 22D

The STADAN consists of 17 world wide stations. Since the network is primarily a user of time, it is vitally interested in present and future timing systems. Funds are made available for more accurate and precise timing systems only as justified by a reasonably firm requirement. Thus far the requirements of the experimenters have called for absolute accuracies in the region of one-half second and uniformity or self consistency of milliseconds. At present our firm requirement for greatest accuracy is ± 100 microseconds based on accuracy of present Range and Range Rate tracking systems. A laser tracking system under development may push this to 10 microseconds if that system becomes an operational STADAN tracking system. Thus we are examining synchronization systems including: (1) portable clocks; (2) dual very low frequencies; (3) Loran-C; and (4) satellites.
Author

N69-19872*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYNCHRONIZATION EXPERIMENT FOR A TIME DIVISION MULTIPLE ACCESS SATELLITE COMMUNICATION SYSTEM
W. K. Allen and J. G. Dunn (ITT Federal Labs., Nutley, N. J.) *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 107–110 refs (See N69-19856 09-14)
Avail: Issuing Activity CSCL 17B

The described synchronization experiment uses a doppler compensation technique to maintain a sync signal at the satellite whose frequence is essentially uneffected by the doppler. Synchronization is by doppler tracking where one master station tracks the doppler actively and the slave stations tracks it passively. System tests with a medium altitude satellite show a one-way propagation delay from 7 to 38 ms with the maximum doppler at 17 parts/10^6. Timing accuracy between master and slave is better than 1.25 μs guard time with a terminal acquisition time between 5 and 20 seconds.
G.G.

N69-19882*# Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
ADVANCED S-BAND TRANSPONDER STUDY PROGRAM, VOLUME 2 Final Report
Terry Nelson Dec. 1968 576 p
(Contract NAS9-7483)
(NASA-CR-99511) Avail: CFSTI CSCL 17B

The details of an advanced S-Band transponder study program are presented. During this program several block diagram configurations were studied and a simpler and much more flexible configuration was developed. A breadboard model of the new transponder was tested and proven to be feasible. Several closely related theoretical studies were also completed. The results of the analyses, the details of the breadboard design, and the measurements taken are included.
Author

N69-19915 Michigan Univ., Ann Arbor.
MATHEMATICAL MODELING AND PARAMETER IDENTIFICATION FOR A TRACKING SYSTEM
Jerome Arthur Colligan (Ph.D. Thesis) 1968 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-13297

This thesis deals with the problems of mathematical modeling of a nonlinear system with time delay for parameter identification purposes. The particular system considered is a tracking system having a conical scan receiving antenna and a transmitting antenna that tracks but does not scan. Both the receiving antenna and the transmitting antenna are assumed to have symmetric monotonically decreasing directional voltage gain patterns; however, these gain patterns need not be the same. It has been found that the dynamic behavior of the tracking system can be approximated quite well by a system of linear differential-difference equations. A further approximation uses the method of averaging results in a system of linear differential equations. Digital simulation of this linear system is discussed. The use of the linear system of differential equations in the model reference parameter identification technique is then discussed. Dissert. Abstr.

N69-19956 Ohio State Univ., Columbus.
A GEOMETRICAL THEORY OF DIFFRACTION ANALYSIS OF THE RADAR CROSS SECTION OF A SECTIONALLY CONTINUOUS SECOND-DEGREE SURFACE OF REVOLUTION
Charles Edward Ryan, Jr. (Ph.D. Thesis) 1968 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-12872

The radar cross section of a continuous, convex, body of revolution composed of N sections, each section described by a second-degree equation has been analyzed using the geometrical theory of diffraction. Wedge diffraction has been applied to determine the scattered field due to discontinuities in slope between sections of the target, and creeping wave theory has been applied to determine the scattered field due to propagation of energy around the target. A solution for the diffracted field on an axial caustic is presented. An approximate solution for the scattered field near and at the normal direction to a conical generator is developed. A "simplified ray path geometry" for the creeping wave is presented and related to the scattering by spheres and prolate spheroids. The H-plane field of the sphere is calculated using creeping wave techniques for a ray geometry defined by the Poynting vector at the shadow boundary. Dissert. Abstr.

N69-19975 Purdue Univ., Lafayette, Ind.
ADAPTIVE SIGNAL STABILIZATION
Kasim Sinnamohideen (Ph.D. Thesis) 1968 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-12619

A technique whereby an extra signal is introduced at the input to a nonlinear system to improve or otherwise alter its performance is discussed, and four methods of obtaining the signal are proposed. The generation of the stabilizing signal within the system itself, when it has a limit cycle, thereby causes self adaptive quenching or reducing of the amplitude of the self oscillation. In the first method, a minor loop with positive feedback is added to the system such that the overall gain of the system is reduced. The second and third methods utilize the idea that in a nonlinear system the output of the nonlinear element has higher harmonics of the fundamental frequency at which the limit cycle occurs. These higher harmonics can be suitably filtered and used as stabilizing signals. In the fourth method, it is shown that an added minor loop, which has a limit cycle of its own at a higher frequency than the system limit cycle, can be employed to stabilize the system. All methods are illustrated by analog computer simulation. The transients of the output of the system after the introduction of the stabilizing signal are also analyzed. The systems are all single loop with a nonlinear element followed by a linear component. The nonlinearity is assumed to be time invariant and frequency independent. Dissert. Abstr.

N69-19997* Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
STATISTICAL COMMUNICATION THEORY
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 157–168 refs (See N69-19981 09-34)
(Grant NGR-22-009-304; Contract DA-28-043-AMC-02536(E))
Avail: CFSTI CSCL 17B

We have presented a small-signal method for determining jitter in regenerative switching circuits. When applied to the tunnel diode switch, the method quite dramatically provided new insight into the mechanism whereby noise fluctuations cause jitter. Although, in practice, this method is only applicable when the noise is "small enough," the fact that the method works over a wide operating range for the tunnel diode switch indicates that the noise in that switch is indeed "small enough" over that range. It appears that this method for determining jitter in switches is a very powerful technique; application of the technique to other regenerative switching circuits may yield valuable circuit design techniques for minimizing jitter in those circuits. Author

N69-20031 University of Southern Calif., Los Angeles.
SCATTERING BY RANDOMLY VARYING MEDIA WITH APPLICATION TO RADAR DETECTION AND COMMUNICATIONS
Jimmy Lew Yoke Wong (Ph.D. Thesis) 1968 144 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-12066

The bistatic radar reflecting characteristics of a randomly tumbling dipole are investigated. An expression for the scattered voltage is derived by application of the Lorentz reciprocity theorem. The correlation properties of the received signal are examined. Some statistical assumptions are made in order to obtain readily usable results. A theoretical model is developed for the radar echo from a random collection of moving dipole scatterers. The analysis of the model takes into account some effects of scatterer rotation which have been neglected in previous work. The fluctuating characteristics of clutter echoes are also determined. The theory and some experimental results in the literature are shown to be in relatively good agreement. The properties of random scatter communication channels are also investigated. The constitutive parameters of the scattering medium were assumed to be varying randomly with space and time. The effects of antenna gain were included in the derivation of the channel function in order to take explicit account of the fact that scatterers may flow in and out of the volume illuminated by the two antenna beams. Dissert. Abstr.

N69-20094 Wisconsin Univ., Madison.
DEPHASING ANALYSIS OF TRANSHORIZON TROPOSPHERIC PROPAGATION
Harold Stetson Merrill, Jr. (Ph.D. Thesis) 1968 281 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 68-9103

Tropospheric propagation was investigated using the largely neglected point of view of ray-path geometry as a starting point. This geometry determines the phase and doppler shift of a point scatter as functions of its position and velocity and leads to the new and fundamentally important concept of dephasing, an effect which determines the phase, doppler shift, and amplitude of a non-point scatterer as functions of its position, velocity, size, and structure. Analysis of dephasing was carried out for two models of scatterers: one for the case of propagation via layers of layer-like refractive inhomogeneities, and another for propagation via layers of turbulent refractivity inhomogeneities. The results, when combined

with antenna patterns and (scattering) angle dependance, lead to doppler spectra and to qualitative explanation of differences in signal waveforms and statistics for the two propagation conditions. The result for the turbulence model was basically the same as that of classical turbulence scattering theory, although the assumptions and methods differ. The doppler spectrum models were then used to derive the theoretical envelope spectra and antenna beam swinging average-doppler shift functions. The results compare well with experimental data, thus verifying the validity of the developed theoretical approach and also providing new models for practice. Dissert. Abstr.

N69-20099 Florida Univ., Gainesville.
MINIMUM PHASE ANALYTIC SIGNALS WITH SPECTRA OF INFINITE EXTENT
John Crowell Henry, III (Ph.D. Thesis) 1967 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-13009

This paper studies some properties of analytic signals whose frequency band is not limited. If the real part of the analytic signal is of finite duration it is shown that the analytic signal has singularities on the real time axis. A study of these singularities, however, shows that the general theory off the real axis is still applicable. Using these results, it is possible to obtain a minimum phase analytic signal whose real part is of finite duration. To further ensure realizability of this signal, a condition on the phase function is found which ensures that the signal has a finite rise time and fall time. Two common phase functions found in pulsed radar, constant frequency and linear frequency variation, are acceptable to these requirements. Examples using these phase functions are obtained. Dissert. Abstr.

N69-20110*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POSITION LOCATION AND AIRCRAFT COMMUNICATION EQUIPMENT (PLACE)
Charles R. Laughlin, Roger C. Hollenbaugh, Erwin Hirschmann, and Walter K. Allen Apr. 1967 130 p refs
(NASA-TM-X-63219; X-731-67-159) Avail: CFSTI CSCL 17B

An overall system concept is described which would provide two-way voice and digital data communications between all cooperating aircraft and their associated ground control facilities by means of a transponder aboard a single geosynchronous satellite. Real time surveillance would be provided through continuous position tracking and automatic reporting from telemetry sensors onboard the aircraft. The principle elements of the PLACE (position location and aircraft communication equipment) communication system are the primary control center, one or more alternate control centers, the synchronous satellite, and the cooperating aircraft in the coverage area. The position-location system uses a rho–rho technique whereby the position of the aircraft is defined by the intersection of three spheres. A satellite inertial navigation determination (SIND) subsystem has been incorporated into the PLACE design to increase overall reliability. Performance analyses data are included. M.G.J.

N69-20160 Minnesota Univ., Minneapolis.
A FREQUENCY SHIFT KEYING METHOD OF DIGITAL MODULATION OF LASERS USING ANISOTROPIC CRYSTALS
Donald Arthur Smith (Ph.D. Thesis) 1968 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-12305

A unique optical modulation and detection technique has evolved from an investigation of methods of digital modulation, transmission, and detection in the optical region. In particular a frequency shift keying laser communication system has been demonstrated and the advantages of such a system have been shown. A detailed theoretical analysis of electromagnetic wave propagation in an electro-optic crystal of arbitrary orientation was developed. In turn the parameters for an optical modulator capable of frequency shift keying at a digital rate were determined. Based on this analysis a laboratory communication system incorporating FSK modulation and detection capabilities was built and successfully operated. Dissert. Abstr.

N69-20201# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SCATTERING AND ATTENUATION OF CENTIMETER RADIATION BY WATER DROPLETS
K. S. Shifrin et al May 1968 21 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 203, 1967 p 109–122
(AD-681271; FTD-HT-23-49-68) Avail: CFSTI CSCL 17/2.1

The coefficients of scattering, attenuation, and absorption of 0.8, 1.35, 1.8, 2.5, 3.2, 4, 5.6, and 8.5 cm waves by individual water drops of various size (up to 6.6 mm) at temperatures of -10, 0, 10, and 20C were measured. Also given are data on the polydisperse scattering and attenuation coefficients in precipitation particles of various concentrations. Earlier results of these and other authors are refined, extended, and reported in the form of curves and extensive tables. The dependence of the coefficients on particle size, temperature, and wavelength is pointed out. Author (TAB)

N69-20232# Litton Industries, Morris Plains, N. J. Airtron Div.
DUPLEXER FOR SIDE-LOOKING RADAR Final Report, Jan. 1967–2 May 1968
M. King and B. Maher Oct. 1968 25 p
(Contract DAAB07-67-C-0201)
(AD-681238; R11-562; ECOM-0201-F; Rept-2) Avail: CFSTI CSCL 17/9

The report describes the research and development directed towards advancing the state-of-the-art in the field of microwave components intended for application in a side-looking radar. A three-port E-plane junction circulator was developed capable of operating at a peak power level of 500 kw and an average power of 650 w. Single crystal yttrium iron garnet was employed as a power sensitive element in a completely solid state limiting device capable of operating at a peak power input of 50 kw. Author (TAB)

N69-20262# Brown Univ., Providence, R.I. Div. of Engineering.
RADAR REFLECTING PROPERTIES OF CONDUCTING SURFACES Final Report, 15 Feb. 1966–29 Feb. 1968
Donald M. Bolle Jun. 1968 14 p refs
(Contract AF-19(628)-5846)
(AD-680828; AFCRL-68-0346; SR-AF-5846/6) Avail: CFSTI CSCL 17/9

Problems investigated were in the areas of propagation through inhomogeneous media and scattering from perfectly conducting bodies of arbitrary shape in both the frequency and time domain. Author (TAB)

N69-20341# Signals Research and Development Establishment, Christchurch (England).
ELIMINATING THE EFFECT OF SITE REFLECTIONS ON RADIATION PATTERNS OF MICROWAVE AERIALS
T. K. Fitzsimons Jul. 1968 10 p refs
(AD-680982; SRDE-68018) Avail: CFSTI CSCL 9/5

A method for revealing the effect of site reflections on aerial radiation pattern measurements is described. The method can be used to identify the source of the reflections and also to eliminate their effects. Author (TAB)

N69-20364 Michigan Univ., Ann Arbor.
THE THREE-DIMENSIONAL PHASED ARRAY: PHYSICAL REALIZABILITY AND DIRECTIVE PROPERTIES
Thomas Otto Mottl (Ph.D. Thesis) 1968 236 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.05 Order No. 68-13357

Two fundamental aspects of volume arrays of elementary radiators were studied. An analytical model of an array of short dipoles with completely arbitrary configuration was formulated as a basis for an extensive theoretical investigation of the directivity. Parameter and its relationship to the various dimensional parameters of a three dimensional array geometry. Subsequently, an experimental model of a three dimensional dipole array, was constructed and measurements performed to demonstrate the degree of agreement between experiment and theory. Analysis of the directivity expression for the theoretical array resulted in an exact expression for the directivity of general array configurations of short dipoles. This general expression was then specialized to the particular cases of arrays with rectangular geometry in one, two, and three dimensions; i.e., linear, planar, and lattice arrays. The experiments focused on obtaining measurements to verify the feasibility, or realizability, of the three dimensional array concept in the form of a 4 × 4 × 4 (64 elements) lattice array. The degree of correlation between theoretical and experimental radiation patterns and directivity were chosen as a measure of such verification. The theoretical investigation resulted in values for maximum nominal directivity, and optimum element spacings related to maximum nominal directivity, for planar arrays, planar arrays backed by ground planes, and lattice arrays of various sizes. The experiments resulted in measured radiation patterns and array gains which showed good agreement with theory in almost all cases. In addition to these measurements, some data on mutual coupling effects were also obtained. These data led to the conclusion that the array radiation pattern and directivity value were not strongly influenced by such effects. Dissert. Abstr.

N69-20365 New Mexico Univ., Albuquerque.
TRANSIENT PULSE TRANSMISSION USING IMPEDANCE LOADED CYLINDRICAL ANTENNAS
David Evan Merewether (Ph.D. Thesis) 1968 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-13077

Two aspects of the problem were considered. First, an approximate solution was obtained for the current distribution on a thin cylindrical antenna driven at an arbitrary point along its length. This solution may be applied to an antenna of any length, and its simplicity makes the current distribution rapidly computable. It is ideal for the prediction of the transient electromagnetic field radiated when an arbitrary voltage transient is impressed across the input terminals of a long, thin, cylindrical antenna loaded with lumped impedances. Second, an antenna synthesis procedure was evolved. This synthesis procedure yields a selection of resistor pairs to be used to symmetrically load a cylindrical antenna so that the radiated electromagnetic field pulse approximates some prescribed waveshape. The length of the antenna required to obtain a useful approximation was also considered. Since a voltage step was the assumed input to the antenna, the waveshape that can be approximated is limited to fast rising, generally decaying functions of time. Dissert. Abstr.

N69-20391# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORETICAL PRINCIPLES OF RADIOENGINEERING STATISTICS
B. R. Levin Mar. 1968 513 p refs Transl. into ENGLISH of Teor. Osn. Statist. Radiotekhniki (Moscow) 1966 p 1–728
(AD-681354; FTD-HT-23-1448-67) Avail: CFSTI CSCL 17/2.1

Modern statistical radio engineering encompasses two fields of system theory: probabilistic analysis and statistical synthesis. This book is devoted only to the questions of probabilistic analysis. Its bases are the corresponding sections of the second edition of the book Teoriya Sluchaynykh Protsessov i yeye Primeneniye v Radiotekhnike (Random Process Theory and Its Application in Radio Engineering) (Soviet Radio Press, 1960). The book contains new results obtained in recent years. Numerous problems for independent solution are included. Statistical radio engineering is beginning to appear in the programs of the schools of higher learning as an independent subject or as a part of other courses. Author (TAB)

N69-20393# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUESTIONS IN THE DESIGNING AND METHODS OF COMPUTING PARAMETERS OF SUPERLONG WAVE AND LONG-WAVE ANTENNAS
B. V. Braude Apr. 1968 30 p refs Transl. into ENGLISH from Antenny (USSR), no. 1, 1966 p 4–21
(AD-680940; FTD-HT-23-1504-67) Avail: CFSTI CSCL 9/5

This is a compilation of antenna-design information based on Soviet and Western published sources. General design principles are discussed; formulas for antenna Q-factor, efficiency, voltage, mechanical load, weight of supporting structures, and antenna-wire diameter are cited. The antenna efficiency and passband depend only on the volume occupied by the antenna system and are independent of the configuration of this system. The antenna voltage is determined by the radiative power; it increases with the height of masts used for supporting the antenna array. Use of higher masts for VLF antennas is deemed expedient. L-shaped, T-shaped, umbrella-type, and valley-type antennas are used. Techniques of calculation and formulas are given for these antenna parameters: static capacitance, natural-resonance wavelength, effective height (with an allowance for wire sag and excitation of metal supporting structures), electric strength, ground loss resistance, antenna efficiency, and special features of multielement antennas. Author (TAB)

N69-20407# California Univ., Berkeley. Lawrence Radiation Lab.
ESSENTIAL NONLINEARITY OF PHASE-SENSITIVE DETECTOR CHARACTERISTICS
Branko Leskovar Aug. 1968 9 p refs Presented at the 6th Allerton Conf. on Circuit and System Theory, Urbana, Ill., 2–4 Oct. 1968
(Contract W-7405-ENG-48)
(UCRL-18301-Rev; CONF-681021-1) Avail: CFSTI

The effect of essential nonlinearity of detector characteristics in a phase-sensitive detection system is studied and determined theoretically in detail over a wide dynamic range of optimum and nonoptimum operating conditions, assuming that the input signal is in the narrow-band Gaussian noise. Minimum, maximum, and limiting values of nonlinearities of detector characteristics are determined by means of computer-aided analysis. Author (NSA)

N69-20440# Sylvania Electronic Systems–East, Waltham, Mass. Applied Research Lab.
INVESTIGATION OF ANTENNAS IN PLASMA MEDIA Final Report, 1 Nov. 1965–31 Oct. 1968
Janis Galets and Michael H. Mentzoni 30 Nov. 1968 45 p refs
(Contract AF 19(628)-5718)
(AD-681150; F-5158-1; AFCRL-68-0616) Avail: CFSTI CSCL 9/5

Slot antenna performance was studied in an ionized environment, and self and mutual admittance and antenna patterns have been measured during a pulsed microwave breakdown. Electron removal and energy relaxation rates are summarized for several atmospheric gases. Antenna impedances were computed for a magnetized cold plasma and for an isotropic warm plasma. The

accuracy of these antenna solutions was studied by examining the surface electric fields excited by approximate current distributions. Author (TAB)

N69-20540# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
A DETERMINATION OF THE G FACTOR EMPLOYED IN THE WAVE INTERACTION ELECTRON ENERGY BALANCE EQUATION
W. I. Miller Nov. 1968 131 p refs
(Contract Nonr-656(35); Grant NSF GP-4622
(AD-681040; SCIENTIFIC-327) Avail: CFSTI CSCL 20/14

The Ionospheric Research Laboratory of The Pennsylvania State University is conducting a radio wave interaction experiment to study the D-region of the ionosphere. The parameters which define the theory of radio wave interaction used to interpret the results of the current experiment are all fairly well known except the fractional excess electron energy loss factor, commonly referred to simply as the G factor, which is employed in the electron energy balance equation. The specific objectives of this work are: to develop a technique to determine the G factor in the D-region; to develop the theoretical basis for such a technique; to make preliminary determinations of the G factor. Author (TAB)

N69-20550# General Dynamics/Fort Worth, Tex.
RAT SCAT RADAR CROSS SECTION MEASUREMENTS OF AN APOLLO COMMAND MODULE MOCK-UP Final Report
Nov. 1968 60 p
(Contract F29600-68-C-0036)
(AD-681086; MDC-TR-68-72; FRXM-69-06) Avail: CFSTI CSCL 17/9

Radar cross section measurements of an Apollo Command Module mock-up were obtained at RAT SCAT. Measurements were taken at frequencies of 2200 and 5690 megahertz with both vertical and horizontal antenna polarizations. In addition, circular polarization and cross polarization measurements were obtained at 5690 megahertz. Target orientations measured were 0 degree pitch: 53, 106, 136 and 172 degrees roll. This report contains no analysis of the data. Author (TAB)

N69-20552# Sylvania Electronic Systems-East, Waltham, Mass. Applied Research Lab.
ON ANTENNA IMPEDANCES IN A COLD PLASMA WITH A PERPENDICULAR STATIC MAGNETIC FIELD
Janis Galejs Oct. 1968 31 p refs
(Contract AF 19(628)-5718)
(AD-681149; AFCRL-68-0576) Avail: CFSTI CSCL 9/5

A flat strip antenna is embedded in a magnetoionic medium with its longitudinal axis perpendicular to the static magnetic field. The antenna characteristics differ for antennas oriented with their surfaces parallel and perpendicular to the static magnetic field. In the former case there are no resistance peaks for frequencies near the plasma frequency and the reactance of a short antenna is capacitive for low frequencies. For frequencies near the gyrofrequency, the antennas are electrically longer for the parallel orientation of their surfaces. The accuracy of the solutions is illustrated by computing the tangential electric surface fields that are excited by the approximate current distributions used in the impedance computations. Author (TAB)

N69-20595# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIO COMMUNICATION OF THE NORTHERN HEMISPHERE WITH ANTARCTICA AT HIGH FREQUENCIES OF SHORT WAVE RANGE
L. P. Kuperov 24 May 1968 8 p Transl. into ENGLISH from Inform. Byul. Sov. Antarkt. Ekspeditsiya, 1955 (USSR), no. 58, 1966 p 53-55
(AD-681242; FTD-HT-23-61-68) Avail: CFSTI CSCL 17/2.1

Some of the problems associated with transequatorial radio communication between Antarctica and the Northern Hemisphere at 22.6 MHz are discussed. The information is based on experience with US equipment at Byrd station. The field intensity of a 22.6 MHz radio signal received from Pearl Harbor at the Byrd station in the Antarctica on the 25th and 26 of March, 1961 is plotted as a function of time. The height of the earth's shadow is also plotted for 30-minute intervals over the radio line connecting Byrd and Pearl Harbor. The author concludes that when one is located in the Antarctica it is possible to select a series of 24-hour radio stations situated above the equator to study the propagation of short waves throughout the tropical region. Of particular interest would be the investigation of short wave radio propagation during total eclipse. If such transmission were possible it would indicate that a High F sub 2 ionosphere layer is present in the tropics and that it would therefore, be possible to have short wave communication between the Northern Hemisphere and Antarctica. Author (TAB)

N69-20601# Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon (France).
ELECTROMAGNETIC WAVE PROPAGATION IN THE PRESENCE OF AN IONIZED JET. APPLICATION TO THE ENGINES OF A CORALIE STAGE [PROPAGATION DES ONDES ELECTROMAGNETIQUES EN PRESENCE D'UN JET IONISE. APPLICATION AUX MOTEURS DE L'ENGIN CORALIE]
A. Rojey 4 May 1968 51 p refs In FRENCH
(Contract ELDO-CTR-17/3/15)
(LRBA-NT-E.1311-NT-8/EAS) Avail: CFSTI

The hypotheses on which rests the computation of the electromagnetic wave projection in the presence of a jet flame, particularly of the Europe 1 launch vehicles, second stage are re-examined. Electromagnetic waves-plasma interactions are considered as well as problems of reflection-diffraction and refraction of the waves. This last mode of transmission seems to be predominant in certain cases. Other phenomena like proximity effects, modifying the antennas behavior, may need further studies considering after-burning, chemical kinetics of combustion and a model of the turbulent mixing zone. ESRO

N69-20645# Mitre Corp., Bedford, Mass.
ERROR CONTROL FOR DIGITAL COMMUNICATIONS IN THE TACTICAL ENVIRONMENT
Kenneth Brayer and Wilfred F. Longchamp Dec. 1968 43 p refs
(Contract AF 19(628)-5165)
(AD-681133; MTP-87; ESD-TR-68-431) Avail: CFSTI CSCL 17/2.1

This paper considers error detection with retransmission and forward error correction for the transmission media used in the tactical environment: i.e., troposcatter and high frequency radio. The results of extensive error pattern measurements in these two media are reported. In the troposcatter channel, bursts with error densities up to 50% and lasting several seconds, followed by several minutes of error-free transmission, are not uncommon. In HF channels, bursts of similar length with short error-free intervals are frequently found; the error density is only 5%. A practical approach used in the design of coding systems (which prevent information degradation) incorporates channel testing. The error patterns that are collected are used in simulation of various coding techniques, with the objective of identifying the most promising. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N69-19657# National Physical Lab., Teddington (England). Aerodynamics Div.
DIGITAL ANALYSIS OF HOT-WIRE DATA
P. W. Bearman Jun. 1968 27 p refs Presented at the Symp. on Instrumentation and Data Process. for Ind. Aerodyn., Teddington, Gt. Brit., 21–22 Nov. 1968
(NPL-AERO-1273) Avail: CFSTI

A relatively cheap means of analyzing hot-wire data digitally is described. The methods of computation and the equipment required to compute root mean square values, auto-correlation functions and power spectral density functions are discussed. The computation of cross-correlation functions and cross-power spectral density functions are also described. To demonstrate the flexibility of the digital analysis system it is shown how hot-wire signals may be linearized and how cross-wire probe data may be analyzed. Author (ESRO)

N69-19717*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE CONVERSION OF FUNDAMENTAL TRACKING DATA TO METRIC FORM
P. E. Schmid Jan. 1969 48 p refs
(NASA-TM-X-63479; X-551-69-3) Avail: CFSTI CSCL 17I

The fundamental tracking data recorded during the track of a space vehicle by a ground station seldom directly expresses the physical measurements involved. In order to directly interpret measured tracking data in terms of physical phenomena, prior to orbit or trajectory computation, a conversion of fundamental tracking data to metric form is required. This conversion is not trivial since it requires an exact knowledge of how each measurement is made, a factor which is a function of both tracking system type as well as system configuration during a particular satellite pass. The tracking data conversion capability discussed in this report was implemented to provide a straight forward means of converting various tracking data types to metric form (i.e. range, range-rate and angles) free from any data preprocessing such as mathematical smoothing or statistical editing. Such metric data is then used as basic information in post-flight tracking data analysis. Author

N69-19729# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
COUPLING OF REAL TIME COMPUTER TO NUCLEAR DETECTOR SYSTEMS [COUPLAGE D'UN CALCULATEUR EN TEMPS REEL A UN ENSEMBLE EXPERIMENTAL DE DETECTION]
Jean Claude Lugol (Ph.D. Thesis–Paris Univ.) Aug. 1968 98 p refs In FRENCH; ENGLISH summary
(CEA-R-3460) Avail: CFSTI

Electronic computers are now included in nuclear physics experimental systems. This corresponds to a general trend to replace conventional multichannel analyzers by on line, real time, computers. An on line computer performing nuclear data acquisition and storage, offers the advantage of reduction and calculation routines in real time, which is needed when the number of experimental parameters increase. A C 90-10 computer of C.I.I. has been connected to the Saclay variable energy cyclotron and the input/output hardware features are described. A main display unit controlling display consoles at many different points has been built for dialogue purposes and it is described along with routine procedures. Author (ESRO)

N69-19776 New York Univ., N. Y.
ON THE TIME REQUIRED TO PERFORM COMPUTER OPERATIONS
Shmuel Winograd (Ph.D. Thesis) 1968 85 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-13146

The minimum time required to perform various functions of the arithmetic unit, and obtain lower and upper bounds for these minimum times is investigated. In obtaining these results, all possible representations of the domain and range of the functions as well as all possible switching circuits which perform the functions are minimized. The functions investigated are those connected with performing addition and multiplication and of comparing two numbers. It is shown that the minimum time to perform multiplication modulo N is about the same as that of performing addition modulo N, and might even be smaller for some choices of N. The average time required to perform addition and multiplication, in the special case that base representation is used, is also studied. The results show that while the average time required to perform addition grows as the logarithm of worst case time, the average time for performing multiplication grows as the worst case time. Dissert. Abstr.

N69-19998 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
PROCESSING AND TRANSMISSION OF INFORMATION
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 169–186 refs (See N69-19981 09-34)
(Grants NsG-334; NGR 22-009-304)
Avail: CFSTI

Analyzed is the angle-of-arrival dispersion of a plane wave traversing a two dimensional cloud by defining the angular intensity distribution function for the total intensity of all plane waves at a point in a cloud layer model. Fourier transforms of Boolean functions are studied by correspondence between Fourier coefficient sets and equivalance classes establishing conditions for generating the set of numbers in the transform domain. G.G.

N69-20000 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
SPEECH COMMUNICATION
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 217–219 (See N69-19981 09-34)
(Contracts AF 19(628)-5661; DA-28-043-AMC-02536(E); Grants NIH 5-RO1-NB-04332-05; NIH 1-PO1-GM-14940-02)
Avail: CFSTI

The Speech Communication Group has recently acquired a medium sized general-purpose digital computer for online usage, and has added to the system peripherals that are primarily oriented to the processing of types of data relevant to speech research. The central processor of the system is an 18-bit word length machine. The present configuration includes an ITT display monitor consisting of a 16-inch cathode-ray tube with a useful plotting area of approximately 10 inches square. The maximum point plotting rate is approximately 15 μsec per point. Author

N69-20002 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
COGNITIVE INFORMATION PROCESSING
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 241–250 refs (See N69-19981 09-34)
(Contract DA-28-043-AMC-02536(E); Grants NIH 1-PO1-GM-14940-02; NIH 1-PO1-GM-15006-01)
Avail: CFSTI

Procedures are described that will result in a minimum sum of products or a minimum product of sums in the final

realization of digital systems in terms of NAND or NOR gates. Also reported is a computer analysis to evaluate the processing of multilevel digitized pictures by bit-plane encoding. G.G.

N69-20024*# Sylvania Electronic Products, Inc., Waltham, Mass. Applied Research Lab.
MULTIPAC, A MULTIPLE POOL PROCESSOR AND COMPUTER FOR A SPACECRAFT CENTRAL DATA SYSTEM
E. Cohler, T. Baker, G. Cummings, and R. South Mar. 1969 189 p refs
(Contract NAS2-3255)
(NASA-CR-73262) Avail: CFSTI CSCL 09B

A computer was designed for use as a central data system on deep space probes. This computer has the unusual characteristic that it may be repaired during flight through the command and telemetry link by reprogramming around the failed unit. This computer organization uses pools of identical modules which the program organizes into one or more computers. In the event of a failure, new programs are entered which reorganize the central data system. The only effect of such reorganization is to reduce the total processing capability aboard the spacecraft, and therefore some low priority process may have to be eliminated. A detailed description of this design is given including logic diagrams of all modules and interconnection lists for these modules. Further implementation of this design is now proceeding using large-scale integrated circuits. Recommendations for improving the system organization when reimplementing this design are given. Author

N69-20037 Michigan Univ., Ann Arbor.
PROGRAM BEHAVIOR AND CONTROL IN VIRTUAL STORAGE COMPUTER SYSTEMS
Tad Brian Pinkerton (Ph.D. Thesis) 1968 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-13378

This study attempts to resolve some problems in the allocation of storage to computer programs. In both large and small systems, it is necessary to periodically transfer parts of programs between main and auxiliary storage devices. In a small-scale system main memory may not hold an entire program, requiring the exchange of parts of a program for others in order to complete the computation. Parts of programs in large-scale, multiprogrammed systems flow back and forth to main storage in an attempt to keep at least one program ready for execution at any given instant. Several stochastic models are used to represent the behavior of programs with respect to their use of storage. These models are used to suggest ways in which main storage should be allocated in order to maximize the efficiency of the operating system. Dissert. Abstr.

N69-20077 Michigan Univ., Ann Arbor.
AN ASSOCIATIVE PROCESSOR
Tse-Yun Feng (Ph.D. Thesis) 1967 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-13440

An associative memory, because of its ability to retrieve a data word from the memory on the basis of part or all of its *data content*, is well suited for certain types of data processing and search procedures. In this thesis, we developed a fully associative processor which will solve, at least schematically, many of the major current data processing problems. A fully associative memory is first described. This memory utilizes a noise compensation technique developed by the writer. The compensated signal-to-noise ratio which is a factor in determining the memory capacity, would depend on the percentage of the noise compensated rather than on the signal-to-noise ratio of the memory elements directly. As a result, the memory capacity may be greatly increased over that for the uncompensated cases. The noise compensation technique was shown for a few bits in an experiment using multiapertures cores. The propagation delay and attenuation effects were analyzed in relationship to the noise compensation. Dissert. Abstr.

N69-20085 Arizona Univ., Tucson.
THE DESIGN OF A NEW SOLID STATE ELECTRONIC ITERATIVE DIFFERENTIAL ANALYZER MAKING MAXIMUM USE OF INTEGRATED CIRCUITS
Brian Kendall Conant (Ph.D. Thesis) 1968 177 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-12925

This dissertation describes the third generation of high-speed iterative differential analyzer systems designed and built in the Analog-Hybrid Computer Laboratory at the University of Arizona. The APE II system, a new hybrid computer for laboratory instruction, served as a test vehicle for new shielding and packaging techniques and the use of current-mode integrated-circuit logic for digital control of computer operations. LOCUST, an all-solid-state iterative differential analyzer employs 10-V 30 mA amplifiers with 30 MHz unity-gain bandwidth and can operate at iteration rates as high as 2,000 analog computer runs per second as well as in real time. Computing elements are plugged directly into the rear of a modified inexpensive patchbay which has removable patchboards. Subroutines are controlled by a flexible digital control unit as well as by patched digital logic or by an associated digital computer. Dissert. Abstr.

N69-20120 Southern Methodist Univ., Dallas, Tex.
A QUEUEING THEORY STUDY TIME-SHARED COMPUTER SYSTEMS
Philip John Rasch (Ph.D. Thesis) 1967 95 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-12456

A theoretical treatment of the round-robin scheduling and priority queueing strategies for scheduling algorithms of time-shared computer systems is presented. The queueing theory description of service systems is discussed using batch processing as an example. The limiting distributions for the waiting-time and queue-size of the round-robin system, with and without overhead, and the pre-emptive resume priority queueing system are presented. Cost analysis of service systems is discussed. The average value of a program dependent constant times the user waiting-time is the cost measure employed for the comparison of time-sharing systems. In most cases, priority scheduling is superior to round-robin scheduling. Dissert. Abstr.

N69-20121 Auburn Univ., Ala.
THE ORGANIZATION OF A SPECIAL-PURPOSE COMPUTER TO IMPLEMENT A GENERALIZED DIGITAL FILTER FOR SAMPLED-DATA CONTROL SYSTEMS
Hubert Troy Nagle, Jr. (Ph.D. Thesis) 1968 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-13500

A special-purpose computer is organized to implement a programmable digital filter intended for use in sampled-data control systems. A canonical representation for the digital filter is selected, and this form is implemented in functional blocks which are suitable for circuit integration. An analytical technique is discussed which helps determine acceptable quantization resolutions and round-off errors in the digital filter. Experimentation with the digital filter is performed in the pendulous integrating gyroscopic accelerometer control loop and in an analog computer simulation of the Saturn 5 thrust vector control system; the filter used as a digital compensator successfully stabilizes both sampled-data control systems. The performance of the digital filter is examined and organizational techniques to improve its characteristics are proposed. Dissert. Abstr.

N69-20146# National Bureau of Standards, Washington, D. C. Systems Research and Development Div.

INPUT/OUTPUT PACKAGES FOR THE SYSTEMS 360 ASSEMBLY LANGUAGE PROCESSOR

P. A. D. de Maine Sep. 1968 16 p refs

(NBS-TN-433) Avail: SOD $0.25

Three input–output (I/O) software packages for use with the Assembly Language Processor (ALP) of the Systems 360 are described. They are for card read, on-line print and card punch operations. A single pseudo-operation statement, which contains all required formats and addresses, suffices for the execution of each input–output package. Printed error and guide messages aid in program debugging. In addition to the conventional formats (A, I, F and E), Systems 360 column binary (X) and hexadecimal (J and B) are permitted. With a single pseudo-operation these I/O packages can handle up to eight individual items or arrays of any length in a single or mixed format. Author

N69-20182*# Maryland Univ., College Park. Computer Science Center.

A TRANSLATOR SYSTEM FOR THE EULER PROGRAMMING LANGUAGE

Victor B. Schneider Jan. 1969 99 p refs

(Grant NsG-398)

(NASA-CR-100359; TR-69-85) Avail: CFSTI CSCL 09B

The EULER is a generalization of the ALGOL programming language, combining the ALGOL capabilities with many features similar to LISP language. A new syntax is presented for EULER, together with a notation that specifies how EULER is translated. A fast, pushdown-automaton model was used as a basis for designing the translator system, and the design methods used for a portion of the translator are given. Syntactic methods of machine-independent optimization of the translated language are discussed, and a syntactic notation for designing extendible compilers in terms of the EULER language is introduced. The intermediate language into which the EULER is translated is documented. Algorithms for executing the commands of this intermediate language are described, along with versions of the programmed algorithms, rewritten in a subset of EULER. Listings of the actual translator and intermediate language interpreter for the EULER system, consisting of FORTRAN 4-MAP programs written for the IBM 7094 computer, are appended. Author

N69-20239# University City Science Center, Philadelphia, Pa.

EXTENSION OF PROGRAMMING LANGUAGE CONCEPTS Final Report

Philip R. Bagley Nov. 1968 222 p refs

(Contract F44620-67-C-0021)

(AD-680815; AFOSR-69-0023TR) Avail: CFSTI CSCL 9/2

The aim of the study is to find ways of designing new programming languages which have increased flexibility without also having increased complexity. The work is based on the idea that it is possible to design a language which is truly independent of the hardware characteristics of current computers. A new technique of expressing data values, data elements, and data structures has been developed. The technique provides for the construction of arbitrarily-complex data elements, and for arbitrarily-chosen relationships between data elements. All expressions in a program which cause the language processor to take some action, which includes declarations, are viewed as transformations (procedures). A basic set of these transformations has been proposed. The most significant demand on machine design which arises from this research is that much more freedom of storage organization is needed than is provided by conventional machines. Large-scale associative memories could be used to provide some of this needed flexibility of storage. Recommendations for further work are presented and an extensive bibliography on programming language, concepts, and design is appended. TAB

N69-20240*# Auburn Univ., Ala. Engineering Experiment Station.

COEFFICIENT QUANTIZATION IN HYBRID CONTROL SYSTEMS Technical Report, 28 Sep.–28 Dec. 1968

C. L. Phillips 28 Dec. 1968 106 p refs

(Contract NAS8-11274)

(NASA-CR-98359; TR-14) Avail: CFSTI CSCL 09B

The performance of a hybrid control system containing a finite word-length digital subsystem deviates from that obtainable if infinite word-length capabilities are assumed. This deviation arises because (1) the system variables processed by the digital hardware are quantized and (2) the nominal coefficients of the pulse transfer function to be realized by the digital system are quantized. Quantization errors of the second category are considered and a technique is presented for precisely correcting the errors which arise when the nominal coefficients are approximated by digital words of finite length. The correction technique is developed for a digital filter with one approximated coefficient and is then extended to closed-loop hybrid systems with several approximated coefficients. If the correction technique is not feasible, a method is described for optimizing the selection of quantized coefficients relative to a given performance index based on the use of frequency-domain design specifications. An algorithm is presented for generating envelopes on the frequency-response characteristics of continuous- and discrete-time systems subject to parameter anomalies. Author

N69-20250# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HIGH-SPEED DIGITAL RECORDER WITH MAGNETIC TAPE MEMORY

Yu. B. Pavlov et al 23 May 1968 13 p Transl. into ENGLISH from Pribory i Sistemy Upr. (USSR), no. 5, 1967 p 27–30

(AD-680988; FTD-MT-24-109-68) Avail: CFSTI CSCL 9/2

A data register containing an analog-to-digital converter and a tape recording unit has been developed at the Ural Polytechnic Institute. The recorded data format is such that it may be entered directly into the Ural-2 computer. The data register used Ural-10 semiconductor printed-circuit modules. The analog-to-digital converter consists of the following units: control, clock generator, ring shifter, coding circuits, adding and weighing circuits, and comparators. The analog quantities are converted into 12-bit digital equivalents, of which two digits are auxiliary. The magnetic recorder has six tracks, of which one is used for recording synchronization information and the other five for actual data. The tape transport mechanism is the same as that used in the Ural-2 computer system. Author (TAB)

N69-20295# RAND Corp., Santa Monica, Calif.

A GRAPHIC CAPABILITY FOR MARK 4

Harold Casali and Donald Cohen Jan. 1969 9 p

(AD-681108; P-4014) Avail: CFSTI CSCL 9/2

Release 6 of MARK IV was installed on an IBM 360/40. This computer system had been and is still primarily devoted to graphics research. The operating system used is the PCP VERSION OF OS/360. As a part of the graphics research program, a small time-shared system was developed. This system, called SGS, (Simultaneous Graphics System) supports six IBM 2260 graphic terminals. The SGS command language gives a user both text editing and remote job entry capability. It also gives a user the ability to create and modify data files of several types. In order to gain some experience with on-line file management systems in general and to provide a limited production tool for quick response jobs, it was decided that the marriage of SGS and MARK IV was a reasonable path to follow. TAB

N69-20316# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS: RECENT NEWS ITEMS, NUMBER 24
Dorothy McDonald Dec. 1968 103 p refs
(AD-680741; P-3600/24) Avail: CFSTI CSCL 9/2

Contents: Decrees on reorganization of R and D; Theory of experiments; Computerized management of trade and commerce; State prizes awarded; Berg on the information explosion; Annual meeting of Estonian Academy of Sciences; Brief survey of Czech computers; The scientific journal: what should it be; Kaskad production control system; Arkus mathematical computer; ASOR-2 computer for network planning; Centralizing facilities for accountants; N. P. Fedorenko: biographical sketch; Dissertation on programmed learning; and Measuring devices. TAB

N69-20345# Signatron, Inc., Lexington, Mass.
BUILD...A BASE FOR UNIFORM LANGUAGE DEFINITION: A USER'S MANUAL FOR COMPUTER LANGUAGE DESIGNERS AND SYSTEMS PROGRAMMERS Final Report
Richard K. Bennett Jun. 1968 114 p refs
(Contract F44620-68-C-0007)
(AD-681169; SIG-TR-336; AFOSR-69-0072TR) Avail: CFSTI CSCL 9/2

BUILD (Base for Uniform Language Definition) is a system for artificial language definition, which is tied directly to the mechanisms of the translator process. By isolating and utilizing the fundamental elements of computer languages and the fundamental mechanisms of assemblers and compilers, this approach provides a very flexible and powerful base for defining languages and their translators. BUILD is not itself a language, but rather a base for the definition of a wide class of languages. It could be considered as an initial meta-language, although in BUILD no distinction is made between language levels - in particular, between a meta-language and an object language - except as the user desires. This report is written in the form of a users manual to provide an illustration of how the system would appear to the user. The user is an advanced programmer who would use the language for himself for writing a complex program or would define a language for others in a particular applications area. The BUILD approach will provide a comprehensive language and software system. It promises to simplify and unify computer languages so they may be built on one universal base and may all be handled by one general translator and encourages the orderly and rapid development of many powerful new languages tailored to special areas. Author (TAB)

N69-20372# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GENERATOR OF VARIABLE FUNCTIONS
A. S. Parsadanyan Apr. 1968 10 p refs Transl. into ENGLISH from the Monograph "Analogovaya i Analogo-Tsifrovaya Vychislitelnaya Tekhnika" Moscow, 1965 p 441–444
(AD-680989; FTD-HT-23-1614-67) Avail: CFSTI CSCL 9/2

A description is given of a diacrete-analog variable function generator. The generator consists of a programming unit and operational amplifier and multiplication units. The accuracy of reproduction of the functions is controlled by a comparator connected into the feedback circuit. For reproduction of functions with the use of second order curve segments, the generator includes 2 integrators and one invertor. It is noted that the generator allows good reproduction of harmonic functions (for example, by the use of simple programs it was possible to reproduce sounds and words in the upper audio frequency range). Author (TAB)

N69-20415# Naval Research Lab., Washington, D. C.
COMPUTER NELEDIT PROGRAM Final Report
John C. Burgess (Control Data Corp.), Doris E. Gossett, comp., and Douglas P. Shannon, comp. Sep. 1968 15 p
(AD-681018; NRL-MR-1936; NRL-Computer-Bull-2) Avail: CFSTI CSCL 9/2

An edit called NELEDIT has been written in Fortran for the CDC 3800 Computer to provide a method to edit cards or card images under computer operating system control. This program provides a simple method of resequencing, sequencing, printing, inserting, deleting and replacing card images which exist on an input source to the computer. Author (TAB)

N69-20426# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF STORING INFORMATION IN MEMORY DEVICES ON SOLID THIN FERROMAGNETIC FILMS
N. S. Ivanov 16 Apr. 1968 11 p refs Transl. into ENGLISH from Fiziko-Tekhnol. Vopr. Kibernetiki (USSR), no. 1, 1965 p 108–115
(AD-680987; FTD-HT-23-1616-67) Avail: CFSTI CSCL 9/2

Results are presented of an investigation of the effect of digit currents in the adjacent sections of a thin film on the uncalled numbers as a function of the size of both the remagnetized section and the film thickness. It is found that the stability of data storage increases with an increase in the spacing between the axes of digit wires. The most stable are the data recorded on an 85-nm thick film with word wires 0.2-0.4 mm wide, and with the spacing between the axes of digit wires of 1-2 mm. This corresponds to a recording density of 50-100 characters/sq cm. The observed minimum stable domain measured 0.25 x 0.24 mm. Such dimensions corresponds to a recording density of the order of several thousand characters/sq cm. Author (TAB)

N69-20488# System Development Corp., Santa Monica, Calif.
SUBSTITUTION IN FAMILIES OF LANGUAGES
Seymour Ginsburg and Edwin H. Spanier 16 Sep. 1968 44 p refs
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(AD-680785; SDC-TM-738/049/00; AFCRL-68-0592; SR-22) Avail: CFSTI CSCL 9/2

The effect of substitution in families of languages, especially AFL, is considered. Among the main results shown are the following: The substitution of one AFL into another is an AFL. Under suitable hypotheses, the AFL generated by the family obtained from the substitution of one family into another, is the family obtained from the substitution of the corresponding AFL. A condition is given for the AFL generated by the substitution closure of a family to be the substitution closure of the AFL generated by the family. Author (TAB)

N69-20496# System Development Corp., Santa Monica, Calif.
WRITING PUSHDOWN ACCEPTORS
George Mager 14 May 1968 81 p refs Prepared for AFCRL and AFOSR
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(AD-680783; SDC-TM-738/047/00; SR-20) Avail: CFSTI CSCL 9/2

The paper introduces a new automaton, called a writing pushdown acceptor (abbreviated wpda), and investigates some of its properties. A wpda is essentially a two-way pushdown acceptor that can write on its input tape. A number of results about wpda are established. In particular, it is shown that (1) Each set accepted by a wpda is accepted by some wpda that halts for all inputs; (2) the family of sets accepted by deterministic wpda forms a Boolean algebra of sets, contains the family of context sensitive languages, and properly contains the family of sets accepted by deterministic two-way pushdown acceptors; and (3) the family of sets accepted by (deterministic) wpda is contained in the family of sets accepted by (deterministic) stack acceptors. In the deterministic case, the containment is shown to be proper. Author (TAB)

N69-20503# System Development Corp., Santa Monica, Calif.
ABSTRACT FAMILIES OF PROCESSORS
Gene F. Rose May 1968 58 p refs
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(AD-680782; SDC-TM-738/046/00; SR-19; AFCRL-68-0472)
Avail: CFSTI CSCL 9/2

A processor is a Turing-like automaton with auxiliary storage. An abstract family of processors (AFP) consists of all processors that use the storage in the same way. Properties common to all AFP are derived. For a family of operations to be the output functions of some AFP, it is necessary and sufficient that certain word-sets representing its members form a full AFL (i.e. abstract family of languages in the sense of Ginsburg and Greibach) closed under intersection and iterated finite substitution. For a family of word-sets to be the accepted languages of some AFP, it is necessary and sufficient that it be a full AFL closed under interaction and iterated finite substitution. The smallest full AFL of this kind is the family of all recursively enumerable sets. Author (TAB)

N69-20517# Radio Corp. of America, Princeton, N. J.
MODELING DETERMINISTIC SYNTAX ANALYZERS BY REDUCTION PROCEDURES
Daniel A. Walters and Allen J. Korenjak Sep. 1968 67 p refs
(Contract F44620-68-C-0012)
(AD-681131; SR-3; AFOSR-69-0086TR) Avail: CFSTI CSCL 5/7

Bottom-to-top parsers for arbitrary context-free grammars process input strings in exponential time, while parsers for the LR(k) grammars require only linear time. The broad objective of the present investigation is to determine the linearizing features of LR(k) processors so that they can be used in a wider class of parsers. This report describes the results of the first part of this investigation. A model of the LR(k) parsing algorithm is developed in a reduction system which has been previously used to model parsing procedures. By comparing this model to one previously obtained for bottom-to-top parsers, the features of LR(k) grammars and their processors that allow the reduction in parsing time from exponential to linear are exhibited. Author (TAB)

N69-20523# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USING LINEAR GROUP CORRECTING CODES IN A PARALLEL TYPE TSWM (DIGITAL COMPUTER)
Yu. P. Rudnev and Ya. A. Khetagurov Jun. 1968 17 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Elektromekhan. (Novocherkassk), no. 4, 1967 p 406–416
(AD-681312; FTD-HT-23-75-68) Avail: CFSTI CSCL 9/4

The matrix method of code description is briefly considered; as the G-matrix generates a code equivalent to one generated by the G-matrix, any linear group code can be represented in the form of a systematic code; the latter can be described by an H-matrix. Principal classes of linear group codes correcting independent errors are: the Hamming code; W. H. Kautz low-density codes; Bose-Choudhuri cyclic codes; burst-error-correcting codes; Reed-Muller codes. The encoder comprises r multi-input modulo-2 summers whose outputs correspond to r check digits. The corrector (for a systematic n, k-code) comprises a scheme calculating the r-digit correction, a decoder, and a block of 2-input modulo-2 summers; the amount of equipment required is proportional to the number of ones in the H-matrix. Hence, the optimal code has a matrix with the least number of ones and the best code representation. The functional reliability of a redundant system is considered. TAB

N69-20537# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALGORITHMS FOR PLANNING THE PARALLEL OPERATION OF COMPUTER SYSTEM DEVICES
Nguyen Ba Kao Apr. 1968 23 p refs Transl. into ENGLISH from Zh. Vychislitelnoi Mat. i Mat. Fiz. (USSR), v. 6, no. 4, 1966 p 748–757
(AD-680965; FTD-MT-24-91-68) Avail: CFSTI CSCL 9/2

This document is an attempt to find a way to program two computers so that each will execute one of the operations, addition and multiplication, in the shortest possible time, operating simultaneously. Author (TAB)

N69-20565# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SELECTED PROBLEMS IN THE THEORY OF MATHEMATICAL MACHINES
G. E. Pukhov Mar. 1968 266 p refs Transl. into ENGLISH of the book "Izbrannye Voprosy Teorii Matematicheskikh Mashin" Kiev, Izd. AN Ukr. SSR, 1964 p 1–264
(AD-680966; FTD-HT-23-814-67) Avail: CFSTI CSCL 9/2

Contents: Methods of solving algebraic and differential equations; Methods of calculation of electric circuits; Analog and quasianalog methods of modeling; Modeling of mathematical operations; Methods of synthesis of electric circuits of mathematical machines for modeling algebraic objects; Principles of construction of mathematical machines for the solution of problems of linear planning; Toward a theory of devices for the integration of ordinary differential equations; Problems of the synthesis of network electrointegrator circuits; Method of synthesis of control systems. TAB

N69-20570# Naval Research Lab., Washington, D. C.
COMPUTER UTILITY PROGRAM
Thomas L. Rozanski, John C. Burgess, Doris E. Gossett, and Douglas P. Shannon Sep. 1968 16 p
(AD-681017; NRL-MR-1935) Avail: CFSTI CSCL 9/2

A utility program was written in Fortran for the CDC 3800 Computer to provide I/O media to media conversions and/or transfers under computer operating system control. This program provides a simple method to copy, print, compare, punch, skip, or describe records and/or files existing on an input source to the computer. Author (TAB)

N69-20578# Joint Publications Research Service, Washington, D. C.
ANALOG AND ANALOG DIGITAL COMPUTERS—USSR
27 Feb. 1969 43 p refs Transl. into ENGLISH from Analogovaya i Analogo–Tsifrovaya Tekhn. (Moscow), 1968 p 59–80; 153–164; 171–178
(JPRS-47536) Avail: CFSTI

CONTENTS:

1. ANALOG-DIGITAL COMPUTER COMPLEX ATsEMS-1 G. M. Petrov et al p 1–17 refs (See N69-20579 09-08)

2. NEW ATTAINMENTS IN THE CONSTRUCTION OF DIGITAL DIFFERENTIAL ANALYZERS AND THE POSSIBILITIES FOR THE CREATION OF A DIGITAL DIFFERENTIAL ANALYZER DESIGNED FOR SIMULATING COMPLEX CONTROL SYSTEMS N. M. Sotskiy p 18–29 refs (See N69-20580 09-08)

3. COMBINED ANALOG-DIGITAL APPARATUS DESIGNED FOR USE AS CONTROL COMPUTER OF ALL-UNION SCIENTIFIC RESEARCH INSTITUTE OF ELECTROMECHANICS No. 3 B. M. Kagan et al p 30–35 refs (See N69-20581 09-08)

N69-20579# Joint Publications Research Service, Washington, D. C.
ANALOG-DIGITAL COMPUTER COMPLEX ATs-EMS-1

G. M. Petrov et al *In its* Analog and Analog Digital Computers 27 Feb. 1969 p 1–17 refs (See N69-20578 09-08)
Avail: CFSTI

The ATsEMS-1 analog-digital computer complex is a device for mathematical modeling. With the use of this complex, a given system of differential equations may be integrated in real time with analog and digital computers connected for parallel operation and interchange of information through analog-digital and digital-analog converters. The complex is also designed for connection to hardware and additional external equipment not a part of the ATsEMS-1 system. The individual parts of the system (digital computer, analog computers, converters) are independent in the functional sense and may be used not only in the complex, but separately as well for solving special simpler problems. This makes it possible to raise the overall efficiency of the equipment. To increase the effectiveness of problem solving, provision is made for partial automation of data input and output, as well as for checking the results of programming and solution of problems. Diagrams, operational procedures, and descriptions of the equipment are presented in this paper. Author

N69-20580# Joint Publications Research Service, Washington, D. C.
NEW ATTAINMENTS IN THE CONSTRUCTION OF DIGITAL DIFFERENTIAL ANALYZERS AND THE POSSIBILITIES FOR THE CREATION OF A DIGITAL DIFFERENTIAL ANALYZER DESIGNED FOR SIMULATING COMPLEX CONTROL SYSTEMS
N. M. Sotskiy *In its* Analog and Analog Digital Computers 27 Feb. 1969 p 18–29 refs (See N69-20578 09-08)
Avail: CFSTI

A broad review of the present state of digital differential analyzers and their potential use for mathematical modeling and for solving problems of high complexity within an acceptable time segment are reviewed. Recent advances in the theory and principles of design of digital differential analyzers, such as algorithms for arithmetical, differentiating, logical, and control operations; multi-digit increments; and the series-parallel method of construction are discussed. The use of punched cards, punched tapes, and graph plotters for printout is considered. K.W.

N69-20581# Joint Publications Research Service, Washington, D. C.
COMBINED ANALOG-DIGITAL APPARATUS DESIGNED FOR USE AS CONTROL COMPUTER OF ALL-UNION SCIENTIFIC RESEARCH INSTITUTE OF ELECTROMECHANICS NO. 3
B. M. Kagan et al *In its* Analog and Analog Digital Computers 27 Feb. 1969 p 30–35 refs (See N69-20578 09-08)
Avail: CFSTI

The complex is based on the use of VNIIEM-3 control computers together with several types of analog computers and may be used both for solving mathematical problems and for modeling and studying dynamic systems. Working with a combined system permits the simulation of an automatic control system on the control computer in real time under laboratory conditions, the checking of algorithms, and the establishment of the necessary information links between control computer, system, and human operator. A large class of problems solvable on the combined installation involves investigations of the operator-control computer-controlled object problem. The system may also be used as a training aid: in this case the control computer is programmed to give a definite situation as a model and to analyze the operator's actions under predetermined conditions. All necessary information on the simulated situation as well as the operator's actions are reproduced on a manually controlled display panel. In studying complex technological processes, the analog computer is used to simulate electrical drive mechanisms, regulators, or automatic devices used in the machining or processing of a workpiece. The digital computer assumes the function of the control computer. Multichannel converters are of a for information exchange between the analog and digital sections. K.W.

N69-20583# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UNIVERSAL DIGITAL COMPUTER
Li Szu K'Yeng 16 Feb. 1968 7 p Transl. into ENGLISH from Russian Patent No. 168536 (Appl. no 790201/26-24, 9 Aug. 1962) 3 p
(AD-681076; FTD-HT-23-1220-67) Avail: CFSTI CSCL 9/2

The proposed universal digital computer is distinguished by the fact that in it, the memory-accumulator unit is connected to the buffer register with keys for the temporary storage of numbers and shifts which is switched to the operational code decoder which is connected to the memory-accumulator unit, to the address decoder, and to the microprogrammed circuit which is connected to the buffer register and to the address decoder. This enables a decrease in the computer equipment. The productivity of the device is retained, since the arithmetical operations are implemented in the memory unit, because of which the quantity of operations carried out is decreased and the simultaneous load of the various circuits of the computer increases. Author (TAB)

N69-20584# Naval Avionics Facility, Indianapolis, Ind.
FORTRAN PROGRAM FOR STANDARD CELL DATA REDUCTION
R. Leonard Loker and John W. Ingels 26 Aug. 1968 49 p
(AD-681039; NAFI-TR-1270) Avail: CFSTI CSCL 10/3

This report presents a basic program for reduction of standard cell data through computerized techniques. The program, written in FORTRAN language, is adaptable for applications by other standardizing laboratories. A FORTRAN program complete with a sample problem is presented which may be adapted to the requirements of a calibration laboratory where computerized data reduction of standard cell measurements is desirable. Author (TAB)

N69-20599# National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.
USERS GUIDE TO THE NPL GRAPHICAL OUTPUT SYSTEM
B. R. Heap and C. W. Nott Dec. 1968 90 p
(NPL-Ma-63-Rev) Avail: CFSTI

A number of schemes have been produced to enable programmers to make use of graphical output peripherals on the KDF9 computer. In this manual the scheme produced by the National Physical Laboratory is described in detail, it being assumed that the Standard Operating System is used. The first stage of the scheme consists of either a set of short Algol procedure or a set of short Usercode subroutines whilst the second stage is written entirely in Usercode and has the status of a system program. A list of the routines is given, together with a brief description of their effects followed by further sections describing the routines in full detail. Numerous examples are given in the text. ESRO

N69-20605# Data Dynamics, Inc., Los Angeles, Calif.
JOVIAL EVALUATION PROJECT Final Report
William M. O'Brien 15 Oct. 1968 265 p refs
(Contract F19628-68-C-0110)
(AD-681138; ESD-TR-68-452) Avail: CFSTI CSCL 9/2

The results of the evaluation of the JOVIAL Language as specified in Air Force Manual (AFM) 100-24 are contained in this report. This evaluation was based primarily on experience of users of JOVIAL Language dialects. The goal of this evaluation was to recommend deletions, retentions, modifications, and extensions to the JOVIAL language based on the users experience. The methodology of the evaluation consisted of collecting user experience

data by means of a JOVIAL Application Questionnaire and interviews, and evaluating this data based on criteria established and documented in the Approach for Change. This report contains a list of JOVIAL features recommended for deletion and retention and detailed specifications of recommended modifications and extentions to the JOVIAL language. In addition, the report contains the detailed interview notes and questionnaire responses which were the basic data used to arrive at the recommendations. Author (TAB)

N69-20620# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
ELEMENTARY OPERATIONS ON HISTOGRAMS: TRANSLATION, CONTRACTION, EXPANSION [OPERATIONS ELEMENTAIRES SUR HISTOGRAMMES: TRANSLATION, CONTRACTION, DILATATION]
Antoine Becker Sep. 1968 49 p refs In FRENCH; ENGLISH summary
(CEA-R-3481) Avail: CFSTI

A simple model is proposed for analyzer systems which transform a physical system to its analog, and then to a numerical scale. The model determines the physical zero in which, intentionally, only instrumental adjustments of immediate access are made to intervene. When correspondence between the physical origin and the numerical scale has been achieved, one can correct the possible deformations by numerical methods in spite of the use of electronic stabilizers. A very general program has been written to carry out simple operations, e.g. translation and homothetic transformations with constant area. This program and its expression in MAGE II and FORTRAN IV is described in detail. Author (ESRO)

N69-20647# Naval Research Lab., Washington, D. C.
ACCOUNTING FOR COMPUTER USAGE AT THE RESEARCH COMPUTATION CENTER, NAVAL RESEARCH LABORATORY
Sandra Trent Rothwell and Maurice Brinkman Oct. 1968 21 p *Its* Computer Bull.-4
(AD-681019; NRL-MR-1938) Avail: CFSTI CSCL 9/2

This report describes the method used by the Research Computation Center at the Naval Research Laboratory to make appropriate charges for the use of the Control Data Corporation 3800 Computer System. Author (TAB)

N69-20650# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
MATHEMATICAL STUDIES FOR SELF-ORGANIZING SYSTEMS Final Technical Report
Morris Rubinoff, Amy L. Atlas, and Giorgia Ingargiola Griffiss AFB, N. Y. RADC Dec. 1968 95 p refs
(Contract F30602-67-C-0007)
(AD-681143; RADC-TR-68-436, Rept-69-12) Avail: CFSTI CSCL 9/2

Probably the most significant contribution to result from this study is the greater insight into the characteristics of an interesting self-organization system and a reasonable specification of the elementary properties of such systems. A second major contribution has been the detailed description of a universal self-organizing system in the form of a vertex-labelled graph; a direct relation has been established between one such graph and the behavioral description of a universal Turing machine. It is important to note that the resulting computing graph was then extended to include the capability of self-reproduction, a far-reaching result in its own right, and particularly significant in that self-reproduction is accomplished through a process of self-organization. Author (TAB)

N69-20659# Syracuse Univ. Research Corp., N. Y.
THEORY OF ADAPTIVE MECHANISMS. VOLUME 1: CLASS OF PARALLEL PROCESSING AUTOMATA
V. C. Hamacher Griffiss AFB, N. Y. RADC Nov. 1968 125 p refs
(Contract F30602-67-C-0011)
(AD-680792; RADC-TR-68-388-Vol-1) Avail: CFSTI CSCL 9/2

A class of abstract machines called Parallel Processing Automata (denoted PPA) which provides an alternative viewpoint to the concept of iterative arrays is proposed in an attempt to describe some of the properties of parallel computation by means of the simultaneous application of local functions on large arrays of data. The machines of the PPA class are n-dimensional tape Turing machines with (n-1)-dimensional arrays of read-write heads, called read-write units. The formulation of the PPA class is shown to be strongly equivalent to a class of iterative array processors (denoted IAP) which are n-dimensional iterative arrays of identical finite state machines that operate under the direction of a finite state control unit. The control unit processes external inputs and outputs and receives information from an origin cell in the array. At each time unit t of a computation, the control unit determines and broadcasts the state update function that is to be applied to all cells. A programming approach is presented for specifying the operations of the automata studied and its equivalence to the usual state transition function method is shown. Author (TAB)

N69-20660# Syracuse Univ. Research Corp., N. Y.
THEORY OF ADAPTIVE MECHANISMS. VOLUME 3: APPLICATIONS OF THE ITERATIVE ARRAY COMPUTER RADCIAC
W. English and A. Losupovicz Griffiss AFB, N. Y. RADC Nov. 1968 116 p refs
(Contract F30602-67-C-0011)
(AD-680794; RADC-TR-68-388-Vol-3) Avail: CFSTI CSCL 9/2

The following applications of the Iterative Array Computer RADCIAC are presented: Turing machine simulations; and Galois field computations. TAB

N69-20683# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LOGICAL ORGANIZATION OF CONTROLLING A VNIIEM-3 COMPUTER
B. M. Kagan, V. M. Dolkart, G. Kh. Novik, V. V. Stepanov, and M. M. Kanevskii Jan. 1968 21 p refs Transl. into ENGLISH of Elektrichestvo (USSR), no. 3, 1966 p 1–8
(AD-681058; FTD-HT-23-1193-67) Avail: CFSTI CSCL 9/2

The logical design of a new VNIIEM-3 universal control digital computer is explained. The computer is intended for complex automation of processes in various industries (metallurgical, chemical, electric-power, telescopes, etc.). The basic set of the new computer comprises: (1) A central digital computer operating in the real time scale at a rate of 40000 operations per sec; (2) A universal converter with 500 channels capable of analog-to-digital and vice versa signal conversion; (3) A start-stop photo-input device which takes information from a punch tape at a rate of 1000 words per sec and can be interrupted at any syllable; (4) A paper-tape puncher which takes information from the computer at a rate of 20 syllables per sec; (5) An electric typewriter (or teletype) delivering the alphanumerical information; (6) An interruption unit which interrupts the program on an external signal. The form and addressing of numbers, the system of program interruption, the multicomputer operation, the error checking and correction are also explained. Author (TAB)

N69-20698# Massachusetts Inst. of Tech., Cambridge.
A POSITION PAPER ON COMPUTING AND COMMUNICATIONS

Jack B. Dennis May 1968 10 p refs Presented at ACM Symp. on Operating System Principles, Gatlinburg, Tennessee, 1–4 Oct. 1967 Submitted for publication
(Contract Nonr-4102(01))
(AD-669885) Avail: CFSTI CSCL 9/2

The effective operation of free enterprise in creating the envisioned information service industry is dependent upon three accomplishments: (1) The restructuring of our information processing industry so that a clear division of costs is made among computing, communications, and the development of information services; (2) The wide use of multiaccess system concepts so that information services may share in the use of computer installations and so that the cost of their construction is reasonable; and (3) The development of public, message-switched communications services so that adequate provisions are made for information security. (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N69-19734# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
DEVELOPMENT OF A DIFFUSE ELEMENT MATRIX IN 'PLANAR' TECHNOLOGY. A PARTICULAR APPLICATION: LOGICAL GATE WITH COUPLED EMITTER [ETUDE ET REALISATION D'UNE MATRICE D'ELEMENTS DIFFUSES SELON LA TECHNOLOGIE "PLANAR". APPLICATION PARTICULIERE: PORTE LOGIQUE A EMETTEURS COUPLES]
Pierre Rousseau (Ph.D. Thesis—Grenoble Univ., 30 Jun. 1967) 1968 179 p refs In FRENCH; ENGLISH summary
(CEA-R-3422) Avail: CFSTI

After a brief summary of 'planar' technology the various parasitic elements associated with integrated circuit components are discussed. Mathematical formulae for these elements are derived. A description is given of a matrix of 22 transistors and 12 resistors which can be used for the integration of nuclear circuits. Some examples are presented such as an emitter coupled logic gate with useful characteristics. Author (ESRO)

N69-19818# European Organization for Nuclear Research, Geneva (Switzerland).
A SIX-INPUT OR-GATE
F. Nanni and H. Verweij 14 Nov. 1968 14 p refs
(CERN-68-39) Avail: Issuing Activity

A six-input fast OR-gate is described. It has been designed to operate with standard signal levels (0 mV = 0, −800 mV = 1). An output fan-out is incorporated delivering four logic outputs (OR) and one complementary logic output (NOR). Reliable operation is obtained from dc up to 150 MHz. The unit, type N 4132, is part of the CERN-NIM compatible nucleonic instrument range. Author (NSA)

N69-20054 Purdue Univ., Lafayette, Ind.
A p-i-n THERMO-PHOTO-VOLTAIC DIODE
Chang Wook Kim (Ph.D. Thesis) 1968 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-12574

A p-i-n photovoltaic structure is discussed and compared with a conventional p-n junction photovoltaic converter with respect to the efficiency of conversion. The structure consists of an intrinsic region facing the illumination source with interdigitated p and n regions located on the unilluminated surface. The purpose of using an intrinsic region is to obtain longer lifetimes and diffusion lengths. The heavily doped p and n regions result in larger recoverable voltages and higher open-circuit voltages under high intensity illumination. The use of an evaporation process, with suitable masks, allowed precise control of the dimensions of the interdigitated p-i-n structure and led to the formation of heavily doped junctions. Dissert. Abstr.

N69-20073*# Electro-Mechanical Research, Inc., College Park, Md. Aerospace Sciences Div.
AIRBORNE ELECTRONIC RESET FUSE Technical Progress Report, 23 Aug.–18 Oct. 1968
18 Oct. 1968 14 p
(Contract NAS5-11559)
(NASA-CR-99147; TPR-2) Avail: CFSTI CSCL 09A

The breadboard was completed and is delivered. The following modifications and/or optimizations were incorporated: The change from a +7V supply voltage to +12V was not incorporated. To maintain the power dissipation at the present low level, while increasing the supply voltage, is not feasible. The breadboard is capable of demonstrating a fuse of any rating from 1/16 amp to 3 amps. In particular, ratings of 1/16, 1/8, 1/2, and 3 amps will be demonstrated. Energy storage is provided to allow circuit operation for 1.0+ seconds in the event the 7V line was suddenly decreased or shorted. Capability of ground commands to open or close the relay, even in the event of a collector emitter short on Q9, is provided. The time delay versus temperature is significantly improved. The fusing point accuracy versus temperature is stabilized. The time delay variation versus supply voltage changes is reduced. Author

N69-20076 Southern Methodist Univ., Dallas, Tex.
AN APPROACH TO TEST PATTERN GENERATION FOR SYNCHRONOUS SEQUENTIAL CIRCUITS
Robert Stewart Lewis, Jr. (Ph.D. Thesis) 1967 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-11843

Since, in general, the memory elements in an LSI circuit are not directly connected to output terminals, a test method must provide both a means and the necessary notation for propagating the effects of a fault to an accessible output. Thus, the test method to be presented provides for an enumeration of the binary inputs to be applied for the testing of each signal line for a stuck-at-logic-one (SA1) or stuck-at-logic-zero (SA0) fault. To obtain a test that consists of a sequence of terminal binary inputs, a set of priorities is developed that governs the order in which each input pattern is generated. A test pattern generation table is employed to tabulate the necessary data for the input pattern derived. An algorithmic procedure is presented that specifies the entry sequence and content. Thus, the completed generation tables contain the exact binary terminal inputs and expected outputs to be used to test for specific logic faults in LSI-size sequential circuits. Dissert. Abstr.

N69-20129# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
HYBRID INTEGRATED HIGH INPUT IMPEDANCE OPERATIONAL AMPLIFIER
F. Bremsak, S. Hanzel, and P. Erzen Jul. 1968 10 p refs Supported by CEA and the Yugoslav Sci. Found. Comm.
(NIJS-R-538) Avail: CFSTI

Operational amplifiers for application in analog computers and in servomechanisms can now be built very successfully using hybrid technique based on commercial linear integrated circuits and on the use of conventional semiconductor elements. For high input impedance requirements, MOS field effect transistors are used. Minimization of the drift errors is achieved by Goldberg's schema.

which employs field effect transistors, chopper amplifiers, and integrated amplifiers in a.c. coupling. Demodulation is done by transistor, the base of which is connected to the common non-stable multivibrator. The operational amplifier configuration with particular circuits is described, and technical data and results of measurements are given and analyzed. Author

N69-20130# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
SILICON SURFACE BARRIER DETECTORS WITH DEPLETION DEPTH GREATER THAN 2 mm
D. Brajnik, M. Tiringer, and U. Miklavzic Jul. 1968 12 p refs
(NIJS-R-537) Avail: CFSTI

Silicon surface barrier detectors with counting area ranging from 120 to 150 mm^2 and depletion depth larger than 2 mm have been prepared for proton spectrometry. A typical 6 MeV alpha particle resolution at 2 mm depletion depth for a 6300 Ωcm material has been 30 to 45 keV, and 50 to 60 keV for 15 kΩcm and 33 kΩcm material. The corresponding pulse generator resolution has been 25 to 45 keV and 40 to 50 keV respectively. A further increase of depletion depth up to 3 mm (i.e. up to total depletion of detectors) has not increased the resolution of counters made from 15 kΩcm and 33 kΩmm material. Several modifications of standard laboratory methods, concerning inverse layer formation, epoxy encapsulation, and guard ring construction, have been described, and their effect on behavior of the diodes at higher bias compared. Author

N69-20158 New Mexico Univ., Albuquerque.
THE EFFECT OF TRANSIENT IONIZING RADIATION UPON SCHOTTKY BARRIER DIODES
Robert Harold Schnurr (Ph.D. Thesis) 1968 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-13082

The theory of operation of the Schottky barrier diode was reviewed. The complications caused by a more accurate space charge formulation were discussed. Consideration of image effects, tunneling, interfacial dielectric layers, surface states, and minority carrier current was also included. The interaction of ionizing radiation with semiconducting materials was reviewed. The behavior of a Schottky barrier diode in an ionizing radiation environment was considered. The resultant model for the Schottky barrier diode is analogous to a p–n diode with one side having a very high dopant concentration. Tests were performed upon GaAs and silicon Schottky barrier diodes, using a 2mev flash X-ray machine. Both types of diode were exposed to a mixed neutron gamma pulse at the Sandia Pulsed Reactor II. The diodes showed very minor changes in voltage current characteristics for a total neutron fluence up to 1.2×10^{15} nvt. Dissert. Abstr.

N69-20244# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
OPTIMUM SIZES AND SHAPES OF ELECTRODES FOR QUARTZ RESONATORS
R. D. Mindlin Aug. 1968 12 p refs
(Contract DA-28-043-AMC-01731(E))
(AD-681223; ECOM-01731-3) Avail: CFSTI CSCL 9/1

Formulas are given for sizes and shapes of electrode coatings on quartz crystal resonator plates, satisfying the criterion for Bechmanns number in all directions. Author (TAB)

N69-20246 Michigan Univ., Ann Arbor.
NONLINEAR AND FREQUENCY CONVERSION CHARACTERISTICS OF IMPATT DIODES
William Joshua Evans, Jr. (Ph.D. Thesis) 1968 232 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.00 Order No. 68-13306

The large-signal or nonlinear behavior of IMPATT diodes is investigated. The equations relating the current and the voltage in a Read-type IMPATT diode are solved subject to the assumption that the transit time of the carriers through the drift region is small compared to the period of the r-f oscillation. The solution is obtained in closed form and used to calculate the large-signal diode impedance. It is found that the diode impedance above the avalanche frequency decreases with increasing r-f voltage amplitude. This result leads to a significant change in the electronic tuning of an IMPATT oscillator with increasing bias current. The conclusion is verified by experimental measurements, and good quantitative comparison between theory and experiment is obtained. Dissert. Abstr.

N69-20249# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MICROSOUND COMPONENTS, CIRCUITS, AND APPLICATIONS
Ernest Stern 30 Oct. 1968 22 p refs
(Contract AF 19(628)-5167; ARPA Order 600)
(AD-680786; ESD-TR-68-327; TN-1968-36) Avail: CFSTI CSCL 20/1

Acoustic analogs of conventional microwave transmission line (microsound) components on the surface of crystalline substrates should find application in wideband, high-capacity signal and data processors. These microsound transmission lines, hybrids, and couplers interconnect microsound transducers, amplifiers, isolators, and phase shifters to form microsound circuits capable of autocorrelation, Fourier transformation, and matrix permutation functions. Compatible component configurations are proposed and evaluated which perform the basic functions of wave guidance, amplification, isolation, and transduction. The anticipated difficulties with their realization is discussed, and the status of critical problems, including the epitaxial growth of acoustic thin films and sub-micron etching procedures, will be given. Several circuits capable of autocorrelation, cross correlation, Fourier transformation, and matrix permutation are described. Author (TAB)

N69-20306# Signals Research and Development Establishment, Christchurch (England).
COMPUTER AIDED LAYOUT OF MICROCIRCUITS
W. J. Cullyer, Sylvia Tubbs, and A. P. Stockton Sep. 1968 40 p refs
(AD-680981; SRDE-68014) Avail: CFSTI CSCL 9/5

To eliminate some of the skilled human effort in arranging the layout of the components of a microcircuit on a substrate, it is proposed that the process should be aided by a digital computer. A fully automated system does not seem possible at present. The method which has been suggested, and partially developed, relies on the automatic production of a rough layout which is unconstrained in size. This is then rearranged by human intervention, the designer communicating with the machine using a simple drawing language and viewing the progress of the work using an on-line graphical display. Author (TAB)

N69-20310# Ion Physics Corp., Burlington, Mass.
HIGH VOLTAGE BREAKDOWN STUDY Quarterly Progress Report, 16 May–15 Aug. 1968
W. R. Bell, P. C. Bolin, M. J. Mulcahy, F. Y. Tse, and A. Watson Ft. Monmouth, N. J. ECOM Dec. 1968 100 p refs
(Contract DA-28-043-AMC-00394(E); ARPA Order 517)
(AD-680950; OSD-1368; ECOM-00394-15; QPR-15) Avail: CFSTI CSCL 20/3

The report describes the fifteenth quarter of a study of high voltage breakdown in vacuum. The study has particular relevance to problems encountered in the development of high power vacuum tubes. During the present period the first sixteen treatments and four repeat treatments of a 32 treatment experiment were completed. This five-factor, two-level, full-factorial experiment

investigates the influence on vacuum breakdown of anode material, cathode material, anode size, anode shape and electrode treatment. At present the first half of this experiment is complete; and since one factor (anode shape) was held constant during these treatments, the results can be analyzed as a four factor, full factorial experiment. The experimental results and a preliminary analysis are contained in this report. The effects of gas exposure and a transverse magnetic field were also studied by a technique of stacking. Author (TAB)

N69-20409# National Bureau of Standards, Washington, D. C. Electronic Instrumentation Div.

TABULATION OF PUBLISHED DATA ON SOVIET ELECTRON DEVICES THROUGH OCTOBER 1967

Charles P. Marsden Jul. 1968 100 p Supersedes NBS-TN-265 (NBS-TN-441; NBS-TN-265) Avail: SOD $0.55

This tabulation includes published data on Soviet electron devices as collected from publications, mostly handbooks published by the various ministries and institutes of the USSR. Information is given on all active devices ranging from receiving to microwave devices, semiconductor devices, and miscellaneous devices such as photographic flash tubes and thermistors. Author

N69-20413# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DESPITE THE SMALL SIZE OF THE SEMICONDUCTOR

A. Rzhanov Apr. 1968 11 p Transl. into ENGLISH from Sov. Rossiya (USSR), 8 Jan. 1966 p 3 (AD-680775; FTD-HT-23-1566-67) Avail: CFSTI CSCL 9/1

The article is about transistors, which the Russians call a semiconductor triode or amplifier. Their conclusions from experiments is just one, no films applied externally or hermetically sealed capsules can protect the crystal against surface changes. This covers their investigations and research in microelectronics and developing new semiconducting materials. Author (TAB)

N69-20427# Bell Telephone Labs., Inc., Murray Hill, N. J.

NEW LONG DISTANCE BROADBAND COAXIAL WITH LAMINATED AND CORRUGATED OUTER CONDUCTOR

W. G. Nutt, B. Wargotz, and M. C. Biskeborn 1968 37 p refs Presented at the Intern. Wire and Cable Symp. (17th), Atlantic City, N. J., Dec. 1968 (AD-678879) Avail: CFSTI CSCL 9/1

The coaxial, which is expected to replace the older serrated-seam design, has an outer conductor of thin copper laminated adhesively to tin-plated steel. The outer conductor is corrugated to provide good bend performance and crush strength. A soldered seam fixes the electrical diameter of the coaxial and seals against undesired radiation. The major application of the laminated and corrugated coaxial will be in multicoaxial cable for long distance communications between people, computers and control systems. Another important use of the development is a better coaxial for CATV application. Author (TAB)

N69-20445# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE ELECTRON-OPTICAL PROPERTIES OF IMAGE CONVERTER

Ching-kai Shen, Ming Chou, and Tze-chueng Ni 29 Feb. 1968 24 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 21, no. 2, 1965 p 355–368 (AD-680985; FTD-HT-23-1087-67) Avail: CFSTI CSCL 9/1

Graphs are given, showing the dependence of coefficients A, k, the position of Gauss-image plane, and linear magnification on inter-electrode spacing. An approximate formula for calculating distortion-coefficient is derived, which agrees fairly well with experimental result. Design factors are discussed. The authors also determined the percentage of distortion empirically by means of a transparent calibrated plate. The percentage by empirical determination is 7%. Distortions occur in the region and in the field distribution near the cathodes. Distortions can also be caused by electrode configurations. TAB

N69-20521# Library of Congress, Washington, D. C. Aerospace Technology Div.

HIGH-PARAMETER ELECTRIC PULSES: SURVEYS OF FOREIGN SCIENTIFIC AND TECHNICAL LITERATURE

Jan. 1969 48 p refs (AD-680860; ATD-68-61-72-3) Avail: CFSTI CSCL 20/3

The report consists of abstracts dealing with high-parameter electric pulses and their production, the generators for such pulses, and some special, related problems and techniques. Author (TAB)

N69-20571# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMPOSITE TRANSISTOR IN SWITCHING REGIME

Ye. Ye. Yudin 12 Jan. 1968 14 p refs Transl. into ENGLISH from Elektropriborostroeniya i Radioelektroniki (Kiev), no. 7, 1964 p 175–184 (AD-681061; FTD-HT-23-1217-67) Avail: CFSTI CSCL 9/5

Operating conditions of a composite semiconductor triode (ST) in the switching mode are analyzed. The saturation state in both triode components are achieved only when the collectors are separated by an appropriate resistor. Statistical characteristics of the composite triode are established by applying the Ebers-Moll equivalence scheme. Expressions for current in the cut-off mode, amplification in the active mode, and voltages in the saturation state, are driven by a generalized contour current method involving the substitution of a matrix of equivalent resistors. TAB

N69-20670# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

STABILIZED CONSTANT POWER SUPPLY [ALIMENTATION REGULEE A PUISSANCE CONSTANTE]

Louis Roussel Oct. 1968 122 p refs In FRENCH; ENGLISH summary (CEA-R-3631) Avail: CFSTI

The study and realization of a stabilized power supply variable from 5 to 100 watts are described. In order to obtain constant power for lithium drifted diodes a 1% precision of regulation and a response time of less than 1 sec. were sought. Recent developments such as the Hall multiplier and integrated amplifiers now make this possible and one can use modular circuits. Author (ESRO)

N69-20688# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GENERATING NANOSECOND PULSES BY SHOCK WAVES IN A MISMATCHED LOAD

A. N. Mashkov et al Mar. 1968 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved. Radioelektronika(USSR), v. 10, no. 5, 1967 p 477–480 (AD-680929; FTD-HT-23-1441-67) Avail: CFSTI CSCL 9/5

A nanosecond pulse generator is analyzed for the case when the load is not matched to the additional terminal transmission line. This line may be used to connect the generator to a remote load, or it may act as a pulse transformer (one variant of which has coaxial cable windings). Conditions are analyzed for which the pulse reflected from the load is not reflected back from the line and does not distort the output pulse shape. Author (TAB)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N69-19811# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
LOGICAL ANALOG STRUCTURE DEVICE WITH COUNTER-REACTION [DISPOSITIF LOGIQUE DE STRUCTURE ANALOGIQUE A CONTRE-REACTION]
Jacques Uberschlag Dec. 1968 21 p refs In FRENCH; ENGLISH summary
(CEA-R-3665) Avail: CFSTI

An attempt is made to define the principles of logic circuits whose behavior in the case of break-down can be easily detected. The particular circuit described in the report, which is one of the type known as 'majority', is more flexible than conventional ones and makes use of a looped circuit without internal saturation. Author (ESRO)

N69-19908 Illinois Univ., Urbana.
STABILITY OF A CLASS OF LUMPED-DISTRIBUTED SYSTEMS
Jack Jules Bourquin (Ph.D. Thesis) 1968 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-12085

Transfer functions restricted to functions rational in $w = e^{\sqrt{Ts}}$ (T is a real, positive constant) are examined, followed by analysis of this class of functions in the $\sqrt{s}$ plane. In addition, a relationship is established between the transfer function B(s) and H(s) = B($\sqrt{s}$); i.e., where s is replaced by $\sqrt{s}$. It is shown that if B(s) is stable, then B($\sqrt{s}$) must be stable, but not necessarily vice versa. Also, an integral relationship exists between the transient response of B(s) and B($\sqrt{s}$). Dissert. Abstr.

N69-19916 Clemson Coll., S. C.
OPTIMIZATION OF CONTROL SYSTEMS HAVING CROSS CORRELATED SIGNALS
Kenneth Robert Dunipace (Ph.D. Thesis) 1968 150 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-13456

In systems such as floating gimbals, strapdown inertial systems, and high performance aircraft that have time varying coupling, the usual static techniques of assembly, alignment, and calibration are inadequate in reducing cross coupling. A method is presented, based on cross correlation control, in which the cross correlation resulting from coupling is measured, and an estimate of the coupled component is subtracted. An experimental study of the feasibility and advantage of the method was performed on a phototype space navigation platform. Platform disturbances were simulated by equivalent electrical noise signals. The implementation and statistical characteristics of this noise source are presented in detail. The theoretical and experimental results confirm the feasibility of cross correlation control. The effects of loop gains, bandwidth, and system order are presented. The influence of control configuration and of the frequency characteristics of the disturbance and the controlled system were also considered. The most effective results were achieved when two sensors were available on each control axis, and the cross correlation control included integration of the cross-correlation signal. Dissert. Abstr.

N69-19993 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
GASEOUS ELECTRONICS
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 83–84 ref (See N69-19981 09-34)
(Contract DA-28-043-AMC-02536(E))
Avail: CFSTI

The usual first-order perturbation theories used to interpret the cavity data do not take into account the fact that the plasma is surrounded by a quartz tube and that the cavity has end holes for the quartz discharge tube. An experiment has been conducted to account for these errors, and a computer program has been written to predict electron densities from the measured resonant cavity frequency shift. To experimentally determine the errors involved in measuring the electron densities attributable to the quartz tube and the cavity end holes, polystyrene foam was used to simulate low electron densities where the index of refraction is close to that of air. The microwave cavity is a cylindrical brass, silver-plated cavity of 7.003 cm height, 5.403 cm radius, and 1.273 cm end-hole radius for the quartz discharge tube. The end holes are along the cylindrical axis of symmetry with collars extending out to limit end-hole effects. First, the index of refraction of the polystyrene foam was determined by comparing the resonant frequencies of the TM_{020} and TE_{011} modes when the cavity was filled with styrofoam and when the cavity was empty. The index of refraction was found to be $n = 1.0157 \pm 0.0004$ in the region 4000–5000 MHz. Author

N69-19999 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
DETECTION AND ESTIMATION THEORY
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 187–216 refs (See N69-19981 09-34)
(Contract DA-28-043-AMC-02536(E))
Avail: CFSTI

An optical smoother estimates the state vector over an interval where the received signal is observed over the same interval. The equations specifying the structure of the smoother can be found by assuming Gaussian statistics. Analized was a suboptimum receiver for the detection of known signal transmission over a Gaussian, Doppler spread channel in the presence of additive Gaussian white noise, by presenting the bounds on the error probabilities and by comparing receiver performance in several examples. The form of the receiver is suggested by the structure of the optimum filter-squarer detector. G.G.

N69-20086 Pennsylvania State Univ., University Park.
A SYNTHESIS TECHNIQUE FOR IMPROVING THE NATURAL RESPONSE OF A DYNAMIC SYSTEM
Lloyd Wilfred McSparran (Ph.D. Thesis) 1967 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-11995

Consideration has been given to the problem of improving the natural response of a quasi-linear system by feeding back some or all of the system state variables. In order for the system described by a set of linear, first-order differential equations, written in matrix form as $\dot{Y} = A\,Y$, to have a prescribed natural response, these questions are posed: (1) What state variables must be fed back to the input summation point? (2) What should be the gains of the feedback paths? An algorithm for determining the coefficients of the control row is described. The matrix of the partial derivatives of the eigenvalues with respect to the elements of the control row, i.e., the sensitivity matrix, is used in the Newton–Raphson iterative procedure to determine what changes must be made in the control row of matrix A in order to give the prespecified changes in the eigenvalues. Dissert. Abstr.

N69-20093 Michigan Univ. Ann Arbor.
A GENERALIZED STEEPEST DESCENT ALGORITHM FOR MULTISTAGE OPTIMIZATION PROCESSES

Rinaldo F. Vachino (Ph.D. Thesis) 1968 226 p
Avail: Univ. Microfilms: HC $12.15/Microfilm $3.45 Order No. 68-13422

Two optimal control problems which characterize the two classes of multistage optimization processes are formulated. The first is characterized by a known ordering and number of stages, where the succession of the stages is dictated by the presence of staging conditions and jump discontinuity conditions on the state of the system. The second is characterized by an unspecified number and ordering of subarcs. Necessary conditions for the first problem are derived by transforming the problem into a higher-dimensional control problem, utilizing classical results from the calculus of variations. These conditions are then transformed into necessary conditions for the original optimal problem with staging and jump conditions. The perturbations in the number, ordering, and duration of the subarcs, as well as perturbations of the control during each subarc, are treated in a manner similar to that of weak and strong variations of the calculus of variations. The effects are incorporated into variational equations which relate control perturbations to perturbations of the state vector at the final time, and are particularized to problems with and without staging and jump conditions. These equations are reduced to a generalized algorithm composed of two recursive relationships: a generalization of the algorithm of steepest descent, which can alter both the staging times and the control during each stage, and a second relationship to introduce subarcs. Numerical examples possessing one or more of the characteristics of the two multistage optimal control problems are then given. Dissert. Abstr.

N69-20108 Michigan Univ., Ann Arbor.
ITERATIVE NETWORK REALIZATION OF SEQUENTIAL MACHINES
J. Robert Jump (Ph.D. Thesis) 1968 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-13338

The problem of realizing the state transition behavior of sequential machines with iterative networks is viewed as a special type of state assignment problem. The goal is to obtain realizations which display a high degree of uniformity. The approach to the problem is to first define a class of cellular networks, which have the required uniformity, and then to develop coordinate assignment techniques which give rise to networks in this class. This procedure may give rise to very complex networks. The assignment procedure can be used to produce networks with reduced complexity whenever the machine to be realized has certain specified structural properties. The problem of realizing a sequential machine with a binary network (i.e., an iterative network in which the output terminal of any cell can take on only two distinct values) is also studied. Dissert. Abstr.

N69-20163 Purdue Univ., Lafayette, Ind.
OPTIMIZATION OF STOCHASTIC CONTROL PROCESSES WITH RESPECT TO PROBABILITY OF ENTERING A TARGET MANIFOLD
George Edward O'Connor, Jr. (Ph.D. Thesis) 1968 254 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.30 Order No. 68-12595

In this thesis the problem of generating an open loop control to drive a stochastically disturbed system from a given initial state to a target manifold is considered. The control is to be optimum with respect to a performance index which contains a probability term and an energy term. The probability term is the probability of entering the target manifold during some instant of a specified time interval. Two approaches to this problem are investigated. The first approach is to obtain a closed form approximation to the probability term by generating an approximate solution to a diffusion equation, and then applying Pontryagin's maximum principle. The second approach is to formulate an appealing one-parameter class of controls, and search this class over its parameter. In this approach, the probability term is found by observing a digital simulation of the system. Dissert. Abstr.

N69-20186 Purdue Univ., Lafayette, Ind.
SINGULAR TIME OPTIMAL CONTROL
Sadao Hayano (Ph.D. Thesis) 1968 45 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-12562

A slightly different definition of singular time optimal control from the usual sense is given here. A system is said to be singular if more than one optimal control exists for a given boundary condition. The characteristics of the newly defined singular control problem are studied where the system is assumed to be linear, time invariant and expressed by vector differential equations. The controls are Lebesque measurable functions and belong to a compact convex set. It is demonstrated through example that Pontryagin's Minimum Principle is useful for the singular control problem. The minimum principle contains implicit information regarding the singular system. A standard procedure is shown to solve the singular problem. An algebraic interpretation of singularity coincides with the fact that a linear transformation from a function space into the Euclidean space is singular. In order to characterize the class of singular systems, a relation between controllability and the general position condition is discussed. The nonexistence of singular control for a scalar differential equation is proved. Also, it is proved that if singular control exists then there are infinite number of time optimal controls. Dissert. Abstr.

N69-20286 Rensselaer Polytechnic Inst., Troy, N. Y.
THE RELATIONSHIP BETWEEN PERIODIC SOLUTIONS AND STABILITY IN A CLASS OF THIRD-ORDER RELAY CONTROL SYSTEMS
Lawrence H. Michaels (Ph.D. Thesis) 1968 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-13523

Two switch periodic solutions in third-order relay control systems with real non-positive eigenvalues were studied. In investigations of asymmetric periodic solutions, it is shown that such solutions may exist in some third order relay systems, but may be ruled out if the linear portion of the system contains one free integration, or if the closed loop system is required to have a stable equilibrium point at the origin. However, symmetric periodic solutions may exist in systems with a stable origin, and an example is given which indicates this. Results are also given concerning symmetric periodic solutions. By application of Popov's theorem, it is shown that conditions which guarantee that a system will have no symmetric periodic solutions are also sufficient to insure the absolute stability of the origin. This result allows a relay system to be designed by choosing the switching function subject to the constraint that the switching plane avoid a certain region of state space, with assurance that the resultant system will be stable. Dissert. Abstr.

N69-20325 Purdue Univ., Lafayette, Ind.
ON THE RICCATI TRANSFORMATION TECHNIQUE AND THE CONJUGATE POINT CONDITION FOR OPTIMAL CONTROL PROBLEMS AND DIFFERENTIAL GAMES
William Ernest Schmitendorf (Ph.D. Thesis) 1968 186 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-12612

This thesis is divided into two parts. In Part I, linear quadratic optimal control problems are studied. The solution of these problems by the Riccati transformation technique is reviewed. This technique leads to a feedback control law. In Part II, a necessary condition is proved for a differential game analogous to the conjugate point condition for an optimal control problem. This is done by considering an associated minimum problem and an associated maximum problem. Two definitions of a conjugate point and two conjugate

point necessary conditions result. The two definitions and necessary conditions are shown to be equivalent and are combined into one definition and one necessary condition. Two methods of examining a saddle point solution for conjugate points are presented. The first involves the fundamental solution matrices for the accessory minimax problem. The second uses the Riccati transformation technique to solve the accessory minimax equations and end conditions. Dissert. Abstr.

N69-20363 California Univ., Davis.
OPTIMAL CONTROL OF LINEAR TIME-LAG SYSTEMS
Kenton Stanley Day (Ph.D. Thesis) 1967 95 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-12344

A technique was developed for synthesizing the optimal control for systems described by linear vector differential-difference equations with constant coefficients of the form $\dot{x}(t) = A\,x(t) + B\,x(t-\tau) + C\,u(t) + D\,u(t-\tau)$ where τ is a constant time delay, and the performance index is $I = \int_0^\infty [x' Q x + u' H u]\,dt$. The difficulty in solving this system directly is that the state is infinite in dimension. The continuous system and performance index were discretized, and the discrete system with delay was embedded into an enlarged discrete system without delay. To do this, it was assumed that the trajectory is piecewise linear for the duration of the lag interval τ, and that sampling takes place at submultiples of τ. Then the method of dynamic programming can be applied to the resulting finite-dimensional difference equation in order to determine the optimal control law. This results in a controller with memory. Instability may arise in the system using the above stated controller because approximations are used in describing it. Therefore, a stability criterion was stated which may be applied to the given continuous system. Examples are included to illustrate the new method. It was found that the performance index for a given plant was always better using the new method than when optimization was carried out by existing methods. The improvement was always more significant for larger values of time delay. This is because the new method gives a better approximation to the continuous system when the delay is large. The method is entirely computer oriented, and all recursion formulas are derived. Dissert. Abstr.

N69-20389# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y.
A THEORY OF BROADBAND MATCHING OF FREQUENCY DEPENDENT GENERATOR AND LOAD
Ta-Mu Chien Griffiss AFB, N. Y. RADC Dec. 1968 120 p refs
(Contract AF 30(602)-3951)
(AD-680795; PIBEP-68-010; RADC-TR-68-434) Avail: CFSTI CSCL 20/3

The classical theory of matching an arbitrary load to a resistive generator to achieve a desired power gain is extended to matching an arbitrary load to a generator with arbitrary internal impedance. Given the load and generator impedances and the desired power gain, the necessary and sufficient conditions on the power gain has been established such that there exists a lumped lossless 2 port which, when operated between two given impedances, realizes the desired power gain. The constraints on the gain function are formulated in coefficient and integral form. Design procedures are outlined and illustrated by several non-trivial examples. A design chart is prepared to facilitate the engineer to carry out the details involved. Author (TAB)

N69-20499# Michigan Univ., Ann Arbor. Logic of Computers Group.
ON THE FEEDBACK COMPLEXITY OF AUTOMATA
Bernard Phillip Zeigler Jan. 1969 162 p refs Sponsored in part by Natl. Inst. of Health
(Contracts DA-31-124-ARO(D)-483; N00014-67-A-0181)
(AD-681082; REPT-08226-6-T) Avail: CFSTI CSCL 9/2

Given a behavior, as embodied in a finite state transition function what is the minimum level of feedback complexity required by a logical net which can simulate this behavior. For any given level of complexity is there a transition function which cannot be simulated by any logical net characterized by this complexity level. To answer these questions we: (1) Consider five main classes of behavior realization: simulation, mutual pi-simulation, homorphic realization, expansion limited realization and isomorphic realization does not and simulation allows computational slow-up which homomorphic realization does not. In mutual pi-simulation the semigroup must be preserved while expansion limited realization corresponds to the use of covers for state splitting; (2) Construct representing digraphs for logical nets and characterize the reduced digraph of a simulation; (3) Select as measures of complexity of a logical net: (a) the size of the largest strong component of its representing digraph and (b) the largest of feedback indegrees of the points in the representing digraph. Here the feedback indegree of a point is the number of input lines it receives from points in the same strong component. Author (TAB)

N69-20543# Avco-Everett Research Lab., Everett, Mass.
THE ROLE OF LANDAU DAMPING IN CROSSED-FIELD ELECTRON BEAMS AND INVISCID SHEAR FLOW
R. J. Briggs, J. D. Daugherty, and R. H. Levy Dec. 1968 76 p refs
(Contracts AF 49(638)-1553; AT(30-1)-3863)
(AD-681160; AERL-RR-317; AFOSR-69-0087TR; NYO-3863-9)
Avail: CFSTI CSCL 20/9

Under certain circumstances the problem of the stability of low density crossed-field electron beams is precisely analogous to the problem of the stability of incompressible inviscid shear flows. The electron density, the drift velocity, and the potential correspond to the fluid vorticity, velocity, and the stream function respectively. The analogy is valid only for waves propagating in the direction of the unperturbed velocity. Neutrally stable normal modes of oscillation that are found when certain suitable step-function unperturbed electron density (vorticity) profiles are assumed seem to disappear when small gradients are present. In the context of a Laplace transform solution of the initial value problem, the vanishing normal modes can be found by analytic continuation of the solution onto another sheet of the cut complex omega-plane. The recovered modes are found to be damped by a fluid-wave resonant interaction which closely resembles the Landau damping of plasma oscillations in warm plasmas by particle-wave resonance. An interesting feature of the neutral waves is that they have a negative energy and so are destabilized by the removal of energy from the system (for example, by slightly dissipative walls). The sign and magnitude of the Landau damping term is evaluated for a simple case and compared (for the electronic case) with the growth provoked by slightly lossy walls. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N69-19715# Federal Aviation Administration, Atlantic City, N. J. National Aviation Facilities Experimental Center.
TEST AND EVALUATE RUNWAY ALIGNMENT INDICATOR LIGHT (RAIL) FOR APPROACH GUIDANCE Final Report
Bernard Weinstein Mar. 1969 30 p refs
(NA-69-7; RD-69-8) Avail: Issuing Activity

A comparison of the Runway Alignment Indicator Lights (RAIL) with the Medium Intensity Approach Light System (MALS) for effectiveness in providing identification and guidance as visual approach aids has been completed. The two aids were flown alternately in each available weather condition to permit comparison. The results obtained from pilot questionnaires and radar data during day and night IFR/VFR operations with weather minimums down to 3/4-mile visibility indicated the following: While the RAIL provided earlier identification and displacement information than did the MALS, the glare from the RAIL was so distracting during VFR night operations that pilots considered the RAIL unacceptable. On the other hand, the MALS was acceptable during day and night IFR/VFR operations and was rated the better approach aid during VFR night operations. It was recommended that RAIL not be approved for operational use. Author

N69-19793*# Techtran Corp., Glen Burnie, Md.
THE PROBLEM OF BRAKING BARRIERS: THE HISPANO-SUIZA DESIGN [LE PROBLEME DES BARRIERS D'ARRET: LA REALISATION D'HISPANO-SUIZA]
M. Laining Washington NASA Mar. 1969 6 p Transl. into ENGLISH of the FRENCH Rept. Presented at the 8th Intern. Aeron. Congr., Paris, May 1967
(Contract NASw-1965)
(NASA-TT-F-12135) Avail: CFSTI CSCL 01E

Details are given on the development of a barrier capable of strongly braking a civil aircraft as it reaches the end of the runway still rolling at high velocity but where the takeoff is aborted. The braking barrier capable of stopping an aircraft consists of a stretched, flexible net placed across the runway. The aircraft, running into the net, would carry it away if it were not connected by links to a system of brakes. The solution presented used direct braking by means of a flat strap arranged in accordion fashion. The characteristics of a military braking barrier capable of stopping an aircraft of 30-ton takeoff weight and rolling at 330 km/hr are described. Author

N69-19807# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
DETERMINATION OF THE 20 MeV LINEAR ACCELERATOR, NEW INJECTOR FOR THE SYNCHROTRON SATURNE. A CHOICE OF THE ELECTRICAL AND DYNAMICAL PARTICLE PARAMETERS [DETERMINATION DE L'ACCELERATEUR NUCLEAIRE DE 20 MeV, NOUVEL INJECTEUR DE SYNCHROTRON SATURNE. CHOIX DES PARAMETRES ELECTRIQUES, DYNAMIQUE DES PARTICULES]
Michel Promé (Ph.D. Thesis--Paris Univ.) Dec. 1968 106 p refs In FRENCH; ENGLISH summary
(CEA-R-3261) Avail: CFSTI

This report forms part of the general determination of the 20 MeV linear accelerator which will be the new Saturne injector and it deals with particle dynamics. Starting from beam requirements at the output of the linac, cell lengths with variable synchronous phase angles, buncher and debuncher parameters and beam emittances at the output in several phase spaces are successively determined. Author (ESRO)

N69-19823# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
FOCUSING OF CHARGED ELECTRON RING IN THE COLLECTIVE ION LINEAR ACCELERATOR
A. G. Bonch-Osmolovskii, G. V. Dolbilov, I. N. Ivanov, E. F. Perel'shtein, V. P. Sarantsev et al 1968 10 p In RUSSIAN
(JINR-P9-4135) Avail: CFSTI

Problems of charged electron ring focusing in the collective ion linear accelerator are discussed. Three types of focusing are considered: focusing of the azimuthal component of the magnetic field, focusing by counter waves and focusing by the image forces. The conditions of the stability of the electron oscillations in the ring are obtained and the possibilities of applying the above-mentioned types of focusing are determined. Author (NSA)

N69-19961# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Institut fuer Raumsimulation.
THE SIMULATION OF COLD BLACK SPACE IN THE SPACE CHAMBER OF THE DVL IN PORZ-WAHN [DIE NACHBILDUNG DES KAELTEHINTERGRUNDES IN DER GROSSEN RAUMKAMMER DER DVL IN PORZ-WAHN]
G. Klein Dec. 1968 98 p refs In GERMAN; ENGLISH summary
(DVL-787; DLR-MITT-68-30) Avail: CFSTI

A brief description of general requirements for shrouds of space environment simulation chambers is followed by a discussion of the suitability of various cryogenic systems using gaseous or liquid heat transfer media for cooling the shroud. A detailed description is presented of the LN_2-cooled shroud used in the space simulation chamber of this facility. This chamber has a test volume of 2.5 m diam by 5.25 m length. Technical aspects, the thermodynamic function, the cooling system, controls, the measuring system, and safety measures are described. K.W.

N69-20139# Council for Scientific and Industrial Research, Johannesburg (South Africa).
SATELLITE TRACKING ACTIVITIES OF THE JOHANNESBURG STADAN Monthly Report
W. J. Botha Jan. 1969 18 p
Avail: CFSTI

Summaries of the operational activities, and analyses of the problems and failures for the Johannesburg STADAN are presented. The areas reported are: (1) computer programs and statistics, (2) communication outages, (3) equipment failures, (4) maintenance and calibration of electronic equipment, (5) new installations and construction, and (6) logistics support. Tables of operational data are included. F.O.S.

N69-20299*# Texas Christian Univ., Fort Worth. Dept. of Psychology.
A DESCRIPTION OF THE NASA-TCU SPACE VISION SIMULATOR
Malcolm D. Arnoult, Robert J. Vincent, Bill R. Brown, Robert P. Markley, and Robert C. Hensleigh 15 Aug. 1968 22 p ref
(Contract NAS2-1481; Grant NGR-44-009-018)
(NASA-CR-73305) Avail: CFSTI CSCL 14B

The opto-mechanical simulator offers a high fidelity, three dimensional presentation of a space vehicle in a star free outer space environment. Appropriate retinal sizes, binocular cues, and relative brightness changes over a simulated range from 200 ft to 20,000 ft are generated by the device. The objectives of the simulator, its mechanical and optical characteristics, and functional considerations are discussed. Author

N69-20309# Lockheed Electronics Co., Metuchen, N. J.
MONORAIL ROCKET SLED AIR BEARING SLIPPER PERFORMANCE Technical Report, 20 May--5 Aug. 1968
Robert L. Abelt and John D. Richards Holloman AFB, N. Mex. AF Missile Develop. Center Oct. 1968 134 p refs
(Contract F29600-67-C-0056)
(AD-680780; MDC-TR-68-89) Avail: CFSTI CSCL 14/2

The results of dynamic monorail rocket sled tests to evaluate the air bearing slipper concept are presented and discussed. The tests were conducted on the test track at Holloman Air Force Base, New Mexico at velocities up to 4200 feet per second. The prime data collected during the tests were pressure measurements between the sled slipper bearing surface and the test track rail. Secondary measurements of slipper reaction forces, and longitudinal and vertical acceleration were also collected during each test. Author (TAB)

N69-20367*# Army Materiel Command, Hanover, N. H. Cold Regions Research and Engineering Lab.
AN EXPERIMENTAL SNOW RUNWAY PAVEMENT IN ANTARCTICA
Gunars Abele Nov. 1968 30 p refs
(AD-681219; CRREL-TR-211) Avail: CFSTI CSCL 8/12

The strength properties of a Peter miller-processed and -compacted snow runway test strip at McMurdo, Antarctica, and the snow pavement performance during simulated C-130 and C-121 aircraft wheel-load tests are discussed and evaluated. The correlation of shear strength with ram hardness and unconfined compressive strength of high-density snow is discussed and an approximate relationship is developed. Data from actual aircraft and simulated aircraft wheel-load tests on snow pavements are compared with previously developed criteria for snow pavement supporting capacity. Author (TAB)

N69-20451*# National Aeronautics and Space Administration. Washington, D. C.
PAVEMENT GROOVING AND TRACTION STUDIES
1969 512 p refs Conf. held at Hampton, Va., 18–19 Nov. 1968 Film supplement numbers L-775, L-944, and L-947 to this report are available on loan from NASA, Langley Research Center
(NASA-SP-5073) Avail: CFSTI CSCL 01E

The effectiveness of runway grooving as a means for increasing tire traction was discussed at the conference in terms of aircraft performance, aircraft operational problems, results of skid correlation studies, and pavement grooving and surface treatments to improve tire traction on highways. For individual titles, see N69-20452 through N69-20478.

N69-20452*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGHWAY AND RUNAWAY TRACTION STUDIES: THE PROBLEM, HISTORY, OBJECTIVES, AND NASA PROGRAM
Walter B. Horne and E. A. Whitehurst (Tenn. Highway Res. Program) *In its* Pavement Grooving and Traction Studies 1969 p 3–18 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

The problem toward which most traction research is directed is to describe quantitatively by theory and experiment the major causes of pavement slipperiness in terms of pavement, vehicle, tire, operator, and atmospheric or precipitation parameters. Scientific research on the phenomenon of pavement slipperiness has been underway since the early 1920's. Some of the milestones achieved in highway and runway traction research in the United States are summarized. Author

N69-20453*# Air Registration Board, London (England).
RUNWAY AND HIGHWAY TRACTION STUDIES: THE PROBLEM, THE OBJECTIVES, AND THE PROGRAMME IN GREAT BRITAIN. PART 1: RUNWAY TRACTION STUDIES
L. J. W. Hall *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 19–33 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

In addition to fundamental studies of friction, the traction research program in Great Britain is aimed at minimizing the risk of accidents due to inadequate friction. Attempts are being made to discover which paving surfaces provide the highest level of wet friction and least susceptibility to aquaplaning. The durability of the surfaces and their influence on tire wear are also being studied. Criteria and methods for assessing when substandard friction conditions exist and when aircraft are liable to aquaplane are being developed in order to provide engineering and operational control. It is recognized that the program may not result in a sufficient reduction in the number of accidents and that it may be necessary to tackle more vigorously the tire and aircraft aspect of the problem. Author

N69-20454*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPARATIVE BRAKING PERFORMANCE OF VARIOUS AIRCRAFT ON GROOVED AND UNGROOVED PAVEMENTS AT THE LANDING RESEARCH RUNWAY, NASA WALLOPS STATION
Thomas J. Yager *In its* Pavement Grooving and Traction Studies 1969 p 35–65 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

The transverse groove configuration of 1 in. × 1/4 in. × 1/4 in. installed at the landing research runway at NASA Wallops Station for full-scale aircraft test evaluation was selected on the basis of aircraft tire traction tests conducted at the Langley landing-loads track on 19 different transversely grooved test surfaces. Some of the test results obtained at the track are presented and discussed. These results indicate that grooved pavements offer great promise for increasing aircraft ground performance during landing and take-off operations under adverse conditions. Also discussed are the comparative aircraft braking test data obtained on similar grooved and ungrooved surfaces at the landing research runway with a fully instrumented McDonnell Douglas F-4D jet fighter aircraft and the Convair 990 4-engine jet transport aircraft. The aircraft test results substantiate and supplement the track data and indicate that transverse runway grooves provide greatly increased aircraft braking and steering capability for wet, flooded, and slush-covered runway surfaces. Author

N69-20455*# Royal Aircraft Establishment, Farnborough (England).
RAE AIRCRAFT TESTS ON GROOVED, OPEN GRADED AND ASPHALT RUNWAYS IN GREAT BRITAIN
B. Shilling *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 67–80 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

Plans for aircraft tests to determine the wet braking force coefficients obtainable on runways with widely differing surface textures are given. Initial tests made with a Scimitar aircraft on the runways at Farnborough, and the allied work, are described. The results support the view that a harsh, coarse textured surface will give improved braking at aircraft touchdown speeds. Author

N69-20458*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
RESEARCH PILOTS' OBSERVATIONS OF AIRCRAFT PERFORMANCE ON A GROOVED RUNWAY
Fred J. Drinkwater, III, Clark Price (George AFB), and James M. Patton, Jr. (NASA, Langley Res. Center) *In its* Pavement Grooving and Traction Studies 1969 p 115–122 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

Braking effectiveness tests of two airplanes were completed on the landing research runway at NASA Wallops Station. The pilots' observations indicated that transverse groove surfaces

drastically reduced all types of skids on a wet or flooded runway and provided positive nose gear steering during the landing roll-out. The grooved surfaces also prevented the onset of drift and weathervaning. The overall airplane ground handling and stopping characteristics on the grooved surfaces showed a dramatic improvement over those on corresponding ungrooved surfaces with no observable adverse characteristics from the pilots' point of view.
Author

N69-20459*# National Aeronautics and Space Administration. Wallops Station, Wallops Island, Va.
PROBLEM AREAS ASSOCIATED WITH THE CONSTRUCTION AND OPERATION OF THE LANDING RESEARCH RUNWAY AT NASA WALLOPS STATION
Curtis R. Allen and James W. Quillen *In its* Pavement Grooving and Traction Studies 1969 p 123–134 ref (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

The final phases of the construction of a landing research facility at the NASA Wallops Station which was completed early in 1968 are discussed. The test area had grooved and ungrooved sections of concrete and asphalt with various types of finishes. Also discussed is the problem of finding a suitable method for containing predetermined depths of water and slush required for the various tests and the solution of this problem. Problem areas encountered are cited and some adverse side effects which the tests brought to light are described in detail.
Author

N69-20460*# Air Transport Association of America, Washington, D. C.
COMMERCIAL AIRLINES AND THE GROOVED RUNWAY CONCEPT
Edwin W. Abbott *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 135–145 (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

Early research and grooving programs undertaken by NASA and the United Kingdom prompted the airline industry to develop a runway grooving program of its own over two years ago. Behind this decision was the airlines' desire to increase safety and to advance the state of the art in aircraft stopping capability. The airlines felt, however, that before grooving could be considered for widespread use in the United States, operational experience would be needed with grooved runways exposed to heavy use and variable weather conditions. This experience was provided by 15 to 19 months use of grooved runways at three major U.S. airports. On the basis of the airlines' evaluation the Air Transport Association of America is actively seeking the expansion of runway grooving to other airports.
Author

N69-20461*# Air Line Pilots Association, International, Chicago, Ill.
THE AIRLINE PILOTS LOOK AT RUNWAY GROOVING
Carl F. Eck *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 147–151 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

The airline pilots have now had the opportunity to use grooved runways operationally for over a year. They have found significant benefits from this development and desire its universal application at all airports. Because of variable operating conditions and the fact that grooving only allows a wet runway to approach the braking capability of a dry runway, they do not believe that any reduction in runway length requirements on wet runways should result from this grooving.
Author

N69-20462*# Flight Safety Foundation, Woods Hole, Mass.
GENERAL-AVIATION PILOT REACTIONS TO AND OPINIONS ON GROOVED RUNWAYS
George E. Cranston *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 153–164 (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

A survey and analysis study of general aviation pilot reactions to and opinions on grooved runways was conducted by the Flight Safety Foundation. At the time the survey was performed, there were four commercial airports in the continental United States that had at least one grooved runway. Personal interviews were conducted between general-aviation pilots and aviation safety specialists at these sites by using a prepared questionnaire to obtain the data discussed in this paper. The results of the survey and study show that the grooving of runways has a pronounced beneficial effect and provides increased safety for high speed general aviation aircraft operations by the reduction of hydroplaning and increasing braking action during wet runway conditions. Pilots operating light, low speed aircraft did not generally realize these benefits as the runway lengths and widths at these airports far exceeded their operational requirements under all anticipated circumstances involved with this problem.
Author

N69-20468*# Ministry of Public Building and Works, London (England).
PAVEMENT SURFACE TREATMENTS AT AIRPORTS IN GREAT BRITAIN
F. R. Martin *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 235–278 (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

The civil engineering work of the past 12 years is described at airfields in the United Kingdom, to deal with the skidding and aquaplaning problems which first arose there in 1955 when the Royal Air Force began to operate high performance aircraft from relatively short and smoothly finished runways without arrester-gear installations. The possible treatments of existing concrete and asphalt surfaces to improve their skidding resistance, as well as the materials and methods which can be used in new construction, are described and illustrated. Detailed specifications for runway surface treatments which have been used extensively are included. Although the paper is largely oriented to pavement-construction engineers' viewpoint, it also includes reference to airport operators' opinions obtained from the Civil Aviation Division of the Board of Trade and military pilots' opinions obtained from the Ministry of Defence.
Author

N69-20469*# Port of New York Authority, N. Y.
PAVEMENT GROOVING AT JOHN F. KENNEDY INTERNATIONAL AIRPORT
I. J. Dornfeld and James P. Muldoon *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 279–288 ref (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

In August of 1967, The Port of New York Authority completed the grooving of essentially the entire surface of runway 4R-22L at John F. Kennedy International Airport. The grooving pattern was somewhat different from that used at other airports. Major problems included the requirement to return the runway to service on short notice and the disposal of the concrete dust generated by the grooving operation. After 16 months of use, all observations indicate that the grooves are performing their intended function by reducing aircraft stopping distance during wet and flooded conditions. No pavement deterioration or maintenance problems have been noted to date.
Author

N69-20470*# Federal Aviation Administration, Washington, D. C.
REPORT ON GROOVED RUNWAY EXPERIENCE AT WASHINGTON NATIONAL AIRPORT
R. C. McGuire *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 289–300 (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

The Federal Aviation Administration has had an active interest in runway grooving technology since December 1965. A noteworthy accomplishment was the grooving of Washington National Airport runway 18–36 in March 1967. Friction measurements of the runway, which has a 1/8" × 1/8" × 1" groove pattern, show that the grooving alleviates the extreme variations in wet traction caused by surfaces which have been worn smooth and coated with rubber. Tests to determine the effect of environment and traffic on the endurance of 18 groove patterns in concrete and asphalt taxiways are in process at five airports. The cost of grooving the runways at one airport (Chicago Midway) has been included in the Federal Aid to Airport Program. The FAA activities in runway grooving are being coordinated with NASA, the Air Transport Association of America (ATA) and airport authorities who are contemplating implementation of runway grooving. Author

N69-20471*# Kansas City Municipal Airport, Mo.
RUNWAY GROOVING AT KANSAS CITY MUNICIPAL AIRPORT
Howard W. Willoughby *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 301–308 (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

The runway grooving project at Kansas City Municipal Airport has now been completed for about 18 months. The problems encountered during construction and the results as observed by an airport operator will be discussed. Although some minor problems occurred during the grooving, the only major problem was control of the dust caused by the grooving machines. No major problems were encountered insofar as runway maintenance is concerned after approximately 18 months of use. It would appear that runway grooving may have a place in the aviation industry for improving runway traction during inclement weather. No definite conclusions are being drawn from the observations of the project at Kansas City Municipal Airport. The results of this project should be evaluated with the results of projects at other airports in order to determine the effectiveness of the grooving and under what conditions grooving should be initiated at other airports. Author

N69-20472*# Chicago Midway Airport, Ill.
RUNWAY GROOVING PROJECT AT CHICAGO MIDWAY AIRPORT
Michael J. Berry *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 309–311 (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

In November 1967 the entire length of runways 13R/31L and 4R/22L were resurfaced with a continuous pour of concrete 100 feet wide. After the normal curing period for concrete, a slipperiness-when-wet condition arose and caused aircraft hydroplaning. A thorough investigation of this condition was made. After a test demonstration of transverse grooving, the Chicago Department of Aviation submitted a request for labor, material, and equipment necessary to groove both runways in their entirety. The work on this project was completed on September 14, 1968. Author

N69-20474*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
JOINT NASA-BRITISH MINISTRY OF TECHNOLOGY SKID CORRELATION STUDY: RESULTS FROM AMERICAN VEHICLES
Walter B. Horne and John A. Tanner *In its* Pavement Grooving and Traction Studies 1969 p 325–359 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 01B

An extensive skid correlation program was conducted on the landing research runway at NASA Wallops Station to study the degree of correlation existing among braking friction data obtained by 21 different highway vehicles and breaking trailers, by a McDonald Douglas F-4D jet fighter, by a Convair 990 jet transport, and by several currently used methods of predicting aircraft stopping distance on slippery runways. Nine different runway surfaces were tested under wet and puddled and flooded pavement conditions by aircraft with ground speeds up to 135 knots and by ground vehicles with speeds up to 70 miles per hour. Braking results from the two aircraft showed good correlation in rating the relative slipperiness of the nine test surfaces for the pavement wetness conditions studied. Good correlation between the braking results obtained by the different highway vehicles and braking trailers on these surfaces was also shown when factors tending to mask correlation such as braking mode, water film thickness, and vehicle path clearing were accounted for. The current methods for predicting aircraft stopping performance on slippery runways were found to be inadequate. A promising new concept for estimating aircraft stopping distances on slippery runway surfaces, based on ground-vehicle stopping distance measurements, is presented. Author

N69-20586# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
CALCULATION OF THE EXTRACTION SYSTEM FOR SYNCHROCYCLOTRON
V. I. Danilov, V. B. Mukhina, and E. A. Polferov 1968 40 p refs In RUSSIAN
(JINR-P9-4102) Avail: CFSTI

A method for calculation of extraction efficiency is proposed. Calculations were made for a system consisting of a nonlinear regenerator and a hard focusing magnetic channel. Numerical calculations of the initial equations were made with the help of the computer. It is shown that particle losses are determined by the acceptance of the magnetic channel and the shape of the regenerator field. Determining parameters of the magnetic channel are the field gradient of the second section and the thickness of the front plate. The regenerator fulfills the condition of correlation of the radial beam emittance with the magnetic channel acceptance. Author (NSA)

N69-20631# Lockheed Electronics Co., Metuchen, N. J.
FMN 6625 SLIPPER TEST DEVICE
John D. Richards Holloman AFB, N. Mex. AF Missile Develop. Center Aug. 1968 59 p
(Contract F29600-67-C-0056)
(AD-680787; LEC-68-3; MDC-TR-68-90) Avail: CFSTI CSCL 14/2

Measurement of forces and air pressures experienced between the forward slipper and rail on a monorail rocket sled between M = 1.00 and M = 3.00 are presented. Predictions of vertical impact force and frequency are derived. Aerodynamic brake performance is evaluated. An extruded aluminum telemetry pallet and isolation system design and performance are described. Author (TAB)

N69-20632# Lockheed Electronics Co., Metuchen, N. J.
HYPERSONIC MONORAIL ENVIRONMENTAL STUDIES Technical Report, 16 Jul.–5 Aug. 1968
Robert L. Abelt and John D. Richards Holloman AFB, N. Mex. AF Missile Develop. Center Sep. 1968 69 p refs
(Contract F29600-67-C-0056)
(AD-680781; LEC-68-9; MDC-TR-68-91) Avail: CFSTI CSCL 14/2

The results of a one year study program to define slipper loads and slipper gap air pressures on monorail test vehicles are presented and discussed. Two test vehicles, the Instrumented Monorail and the Slipper Test Device, were instrumented to measure the desired unknowns at velocities up to 4200 feet per second.

The study was successful in defining slipper internal pressures for both free stream slipper and wedge shielded configurations. Oscillatory loads were well defined over the test velocities and peak load predictions for up to velocities of 8000 feet per second. Author (TAB)

N69-20641# Rocket Propulsion Establishment, Westcott (England).
A SIX-COMPONENT STAND FOR THRUST VECTOR CONTROL EXPERIMENTS WITH ROCKET ENGINES
D. S. Dean, E. A. Lyons, and D. R. Norman Sep. 1967 62 p
(RPE-TR-67/12) Avail: CFSTI

The design of a stand, capable of resolving the thrust vector of a rocket engine completely in magnitude and direction for thrust deflections of up to 45° from axial, is described. The stand can accommodate engines of up to 25000 N (6000 lbf) axial thrust, and is provided with a built-in calibration system for all planes. The results of the initial tests indicate the necessity for the addition of damping and the design of the damper is discussed. Some features of the digital and analog systems used for recording and analysis of data are mentioned. The results of the commissioning tests, made by means of an external and a built-in calibration system, are given in detail and these show that the errors of measurement are similar to those obtained theoretically, the stand thus meeting the special requirements. Author (ESRO)

N69-20653# Aeronautical Research Council (Gt. Brit.)
THE NEW SYSTEM FOR CONTROLLING THE ATTITUDE AND MOTIVATOR DEFLECTIONS OF A MODEL IN THE R.A.E. NO. 19 WIND TUNNEL
B. E. Pecover Jan. 1968 33 p refs Supersedes RAE-TR-68015; ARC-30215
(ARC-CP-1004; RAE-TR-68015; ARC-30215) Copyright. Avail: CFSTI; HMSO 6s 6d

A new closed loop system is described which enables the incidence, roll and motivator (i.e. control surface) angles of a wind tunnel model to be controlled remotely, either by hand or by analog voltages derived from, say, a computer. Besides operating from direct (polar) demands, the system correctly positions the model if the demands are referred to Cartesian coordinates, and in this case compensation for sting bending can be made automatically. The system is described in some detail and the results of dynamic performance measurements are given. Author (ESRO)

N69-20663# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
DESIGN CRITERIA FOR SNOW RUNWAYS
Guners Abele, Rene O. Ramseier, and Albert F. Wuori Nov. 1968 41 p refs
(AD-681220; CRREL-TR-212) Avail: CFSTI CSCL 1/5

The physical characteristics of snow and those processes of metamorphism which contribute to its strength are important considerations in planning the construction of compacted snow runways. Two distinct temperature-dependent processes affect the physical properties of snow: sintering and strength increase with decreasing temperature. The rate of strength increase and the ultimate strength of snow may be greatly increased by mechanical agitation or depth processing followed immediately by surface compaction. Leveling to produce a smooth surface for aircraft is also necessary. Various combinations of processing and compaction are required depending on the size of aircraft to be operated on the runway. After construction is completed, the natural process of sintering or strengthening must be allowed to proceed for some time before aircraft operations can be initiated. The mechanical properties of processed snow have been correlated with its wheel-load supporting capacity. The correlation shows the effect of such parameters as wheel load, tire contact pressure, and repetitive wheel coverages on the required hardness or strength of a compacted snow layer. Strength profiles which can be expected from certain snow processing and compaction procedures are shown and compared with required strength profiles for various types of wheeled vehicles and aircraft. The purpose of this study was to combine the knowledge gained from fundamental research in the processes of sintering with methods and procedures developed by engineers for using snow as a construction material. Author (TAB)

N69-20669# Aeronautical Research Council (Gt. Brit.)
ON THE DRIVER-RESERVOIR TECHNIQUE. PART I: APPLICATION TO SHOCK AND GUN TUNNELS. PART 2: DETERMINATION OF OPTIMUM RESERVOIR SIZE
L. Davies, K. Dolman, D. R. Brown, and G. Hooper Jan. 1968 54 p refs Supersedes NPL-AERO-1226; ARC-28957; NPL-AERO-1255; ARC-29857
(ARC-CP-1019; NPL-AERO-1226; ARC-28957; NPL-AERO-1255; ARC-29857) Copyright. Avail: CFSTI; HMSO 10s

The driver-reservoir technique is used when an increase in running time is required in shock or gun tunnels. The increase is achieved by effectively eliminating the reflected head of the expansion wave produced when the main diaphragm bursts. A theoretical and experimental appraisal is given of the application of the technique in situations of practical interest, and a method is described for the determination of optimum reservoir size to ensure efficient use of the technique. Author (ESRO)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N69-19613# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE CONFORMAL MAPPING OF A CIRCLE ONTO A RECTANGLE
A. B. Schubert Nov. 1968 45 p refs
(Contract AT(45-1)-1830)
(BNWL-901) Avail: CFSTI

The problem of mapping the closed unit circle onto the closed rectangle, to study the physics of the coupling of adjacent rectangular reactor cells, is discussed. The analysis of the problem is accompanied by a digital computer program which numerically performs the mapping within specified tolerance on a grid of interior points of the circle and the rectangle. Author (NSA)

N69-19669# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Aachen (West Germany). Institut fuer Theoretische Gasdynamik.
SYMMETRICAL POTENTIAL FLOW ABOUT A CYLINDRICAL CONE [DIE SYMMETRISCHE POTENTIALSTROEMUNG GEGEN KREISKEGEL]
R. Schwarzenberger Nov. 1968 27 p refs In GERMAN; ENGLISH summary
(DVL-819; DLR-MITT-68-27) Avail: CFSTI

Boundary layer calculations are simplified when the given outer flow (the potential flow) ends in similar boundary layers. This is always the case when the velocity distribution is governed by the exponential law. Particular solutions of the potential equation corresponding to symmetrical flow around circular cones and having these characteristics have been obtained previously. The velocity is derived by a power function, the exponent of which is dependent on the cone angle. As a completion of such numerical

calculations, complex variables are used in this paper to obtain a representation which gives this dependency with a high degree of accuracy up to rather large cone angles. K.W.

N69-19713# National Physical Lab., Teddington (England). Aerodynamics Div.
A NOTE ON REVERSE TRANSITION
P. Bradshaw 6 May 1968 12 p refs
(NPL-AERO-1262; ARC-30186) Avail: CFSTI

It is shown that the criteria of Preston and of Patel and Head are special cases of a general Reynolds-number criterion which can be deduced as a requirement that there shall be some part of the boundary layer (in practice, the inner layer) in which the containing and dissipating ranges of eddy size do not quite overlap. Author (ESRO)

N69-19721# Aeronautical Research Council (Gt. Brit.).
TWO-DIMENSIONAL LAMINAR COMPRESSIBLE BOUNDARY LAYER PROGRAM FOR A PERFECT GAS
C. C. L. Sells 1968 51 p refs Supersedes RAE-TR-66243; ARC-28503; N68-18058
(ARC-R/M-3533; RAE-TR-66243; ARC-28503) Avail: CFSTI

A computer program has been written to solve the steady laminar two-dimensional boundary-layer equations for a perfect gas at given wall temperature, without wall suction. The program solves the equations at a blunt stagnation point and then solves the equations downstream. Versions for Mercury and Atlas are available. The Atlas program will permit use of linear or Sutherland viscosity laws. Directions are given for setting up problems for solution; the inviscid edge velocity and wall enthalpy, as functions of downstream arclength along the body, are at the programmer's disposal. It appears possible to obtain results correct to at least three significant figures, usually more not too near separation. Author (ESRO)

N69-19723# Aeronautical Research Council (Gt. Brit.)
GRADIENT PROPERTIES OF A MODEL OF STATIONARY RANDOM TURBULENCE
J. G. Jones Jun. 1968 31 p refs Supersedes RAE-TR-67134; ARC-29531; N68-21794
(ARC-CP-998; RAE-TR-67134; ARC-29531) Avail: CFSTI

Histograms for changes in turbulence velocity over given distances are presented, based on a standard power spectral model. It is proposed that these be used as the basis of a comparison between the gradient properties of the models and the measured gradient properties of samples of atmospheric turbulence. An application of the histograms to the gust response of an aircraft with an autothrottle is described. Author (ESRO)

N69-19738 Ohio State Univ., Columbus.
A THEORETICAL AND EXPERIMENTAL STUDY OF THE ANGULAR DISTRIBUTION OF FLUX FROM A KNUDSEN CELL
Thomas Eschman Dunham (Ph.D. Thesis) 1968 282 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 68-12831

Effusion from conical channels in Knudsen cells, including both vapor transport and surface diffusion contributions, is analyzed. A computer solution is obtained for the resulting integro-differential equation describing flow. The effects on effusion of various combinations of channel geometries and surface properties are examined. The angular distributions of silver from nickel cells having cylindrical channels of varying length to radius ratios and from a quartz and a 310 stainless steel cell are obtained experimentally for temperatures near the melting point of silver. The results of the theoretical study indicate that the relative contribution of surface diffusion increases with increasing conical angle, with decreasing channel radius, with increasing channel length to radius ratio, and with increasing surface diffusivity. The experimental results indicate that the angular distribution is a function of channel geometry and the cell-effusate material system. Extensive interactions between silver and nickel are observed. Dissert. Abstr.

N69-19742# National Physical Lab., Teddington (England). Aerodynamics Div.
CALCULATION OF BOUNDARY LAYER DEVELOPMENT USING THE TURBULENT ENERGY EQUATION. PART III: SYNTHETIC STARTING PROFILES
P. Bradshaw May 1968 15 p refs
(NPL-AERO-1270; ARC-30299; FM-3961) Avail: CFSTI

Cole's wall-plus-wake profiles and an assumed mixing length distribution are used to generate plausible velocity and shear stress profiles from input values of skin friction coefficient and momentum thickness. This technique saves time in starting calculations which are expected to be insensitive to initial conditions. Author (ESRO)

N69-19785# Aeronautical Research Council (Gt. Brit.)
DIFFRACTION OF BLAST WAVES FOR THE OBLIQUE CASE
R. S. Srivastava 1968 23 p refs Supersedes ARC-28604
(ARC-CP-1008; ARC-28604) Copyright. Avail: CFSTI; HMSO 4s 6d

The problem of diffraction of an oblique shock wave has been considered. The investigations are devoted to the cases when the relative outflow behind the reflected shock before diffraction is subsonic and sonic. The distribution of pressure has been obtained for finite and infinite shock strengths for both these cases. Author (ESRO)

N69-19791*# Techtran Corp., Glen Burnie, Md.
ENERGY METHOD FOR STUDYING THE TRANSITION FROM LAMINAR FLOW TO TURBULENT FLOW [OB ENERGETICHESKOM METHODE ISSLEDOVANIYA PEREKHODA LAMINARNOGO REZHIMA TECHENIYA K TURBULENTNOMU]
A. N. Shabrin Washington NASA Mar. 1969 9 p refs Transl. into ENGLISH from the book "High Velocity Hydrodynamics" Kiev, Naukova Dumka Press, no. 5, 1968 p 165–171
(Contract NASw-1695)
(NASA-TT-F-12129) Avail: CFSTI CSCL 20D

The application of the Rotta procedure for determining the energy balance of a flow to the analysis of the transformation of a laminar flow to a turbulent flow is described. Formulas for the conversion of local laminar Reynolds numbers to turbulent Reynolds numbers are given. The analytical and experimental results for the energy balances in annular and rectangular tubes are compared. Author

N69-19797 Washington Univ., Seattle.
TURBULENT AIR FLOW OVER SMALL WATER WAVES
George Dale Hess (Ph.D. Thesis) 1968 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-12692

This study represents a preliminary laboratory investigation of the structure of turbulence in air as the air flows over small amplitude, small wave length, wind-generated water waves. The structure of turbulence has been examined through measurements of mean velocity profiles, turbulent intensity profiles, shearing

stress profiles, and energy and dissipation spectra. The energy spectra of turbulence agree well with energy spectra of turbulence under geophysical conditions, indicating the universality of Kolmogorov's similarity theory. In another comparison with geophysical data the wave spectra show a remarkable correlation of data extending over a range of 9 orders of magnitude in the wave spectral density function. The probability distributions of the standard deviation of the wave height, the wave height of the highest one-third waves, and the wave height of the highest one-tenth waves also give good agreement with geophysical data and other wind–water tunnel data, and with theoretical predictions of Longuet–Higgins. Dissert. Abstr.

N69-19810# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

TURBULENT CONDUCTIVITY IN PARALLEL WITH ISOVELOCITIES IN A PLANAR ESTABLISHED FLOW [CONDUCTIBILITE TURBULENTE PARALLELEMENT AUX ISOVITESSES DANS UN ECOULEMENT PLAN ETABLI]

Francois Jullien (Ph.D. Thesis–Paris Univ.) Aug. 1968 97 p refs In FRENCH; ENGLISH summary

(CEA-R-3576) Avail: CFSTI

Experimental results obtained during a study of the turbulent diffusion of heat from a wire source in a flat air flow are discussed. The Taylor statistical laws hold for this arrangement and it was possible to evaluate the influence of the Reynolds number and the distance from the wall on the quadratic values of the velocity fluctuations and the Lagrange turbulence scales. A correlation was found between the Lagrange scales and the friction coefficient when the Reynolds number varies. A diffusion law is derived from Taylor theory which explains turbulent conductivity more clearly. Author (ESRO)

N69-19822 Clemson Coll., S. C.

A THEORETICAL STUDY OF THREE-BODY EFFECTS IN FLUIDS AND BOUND DIMER CONCENTRATIONS IN RARE GASES

Ronald Henry Fowler (Ph.D. Thesis) 1968 67 p

Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 68-13457

Four problems, related to the intermolecular mechanics of fluids, are considered. Results are applicable to the rare-gas elements: neon, argon, krypton, and xenon. Using the known eigenvalues of the Schrodinger equation for the Morse potential, the equilibrium concentration of bound dimers in the rare gases is calculated by a direct statistical-mechanical method. As a part of this calculation the maximum number of stable vibrational and rotational levels of the resultant diatomic molecule is obtained. The calculated concentration of bound dimers is in agreement with experimental data and with published theoretical results calculated by another method. Dissert. Abstr.

N69-19834# National Physical Lab., Teddington (England). Aerodynamics Div.

A COMPUTER PROGRAM FOR THE CALCULATION OF BOUNDARY-LAYER DEVELOPMENT USING THE TURBULENT ENERGY EQUATION

D. H. Ferriss and P. Bradshaw 16 May 1968 53 p refs Supersedes NPL-AERO-1195

(NPL-AERO-1269; NPL-AERO-1195-Rev; ARC-28078) Avail: CFSTI

A computer program for the numerical solution, by the method of characteristics, of a certain system of three quasi-linear hyperbolic partial differential equations is described in sufficient detail for prospective users. Algol and Fortran listings are given. Author (ESRO)

N69-19878 California Univ., Davis.

STEADY AND UNSTEADY POTENTIAL FLOW WITH FREE SURFACES AND GRAVITY

Delmar Dean Fangmeier (Ph.D. Thesis) 1967 98 p

Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-12346

Solutions to steady flow under a vertical sluice gate yield surface profiles and discharge coefficients for gate opening-to-total head ratios in the range $0.1 \leq b/H \leq 0.6$. Comparison with experimental data reveals that variables not considered have a small but significant effect on the flow. The solution consists in mapping the complex-potential plane into an auxiliary plane in which the flow boundaries lie on the real axis. A line distribution of vorticity proportional to the unknown derivative of elevation with respect to velocity potential, together with the Bernoulli equation on the free surfaces lead to an integral equation which exactly describes the influence of gravitational attraction, discharge and flow geometry. A numerical, iterative procedure is used to solve the equation by digital computer to the desired accuracy. Dissert. Abstr.

N69-19897*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

THE PATH OF A JET DIRECTED AT LARGE ANGLES TO A SUBSONIC FREE STREAM

Richard J. Margason (M.S. Thesis—Va. Polytech. Inst.) May 1968 71 p refs

(NASA-TM-X-61529) Avail: CFSTI CSCL 20D

An investigation was made in the Langley 300-MPH 7- by 10-foot wind tunnel to determine the path of the wake from a single jet exiting at large angles to the free stream through a range of effective velocity ratios (square root of the ratio of the free-stream dynamic pressure to the jet dynamic pressure). The jet exit deflection angles ranged from 30° to 180° from the free stream in 30° increments. Photographs taken of the wake, which was a mixture of compressed air and water vapor, showed that the jet paths were essentially the same when the jet is exiting upward and downward as well as when the jet is located adjacent to a large surface or located away from adjacent surfaces. The primary variables determining the jet path are the deflection angle of the jet exit and the effective velocity ratio. The results were compared with equations for the jet path from other investigations, and the best empirical fit to these data was determined. Author

N69-19903*# Techtran Corp., Glen Burnie, Md.

DETERMINATION OF ENTRANCE LENGTH DURING TURBULENT GAS FLOW IN AN ANNULAR TUBE FOR SUBSTANTIAL NONISOTHERMICITY [DLINA NACHAL'NOGO UCHASTKA PRI TURBULENTNOM TECHENII GAZA V TSILINDRICHESKOY TRUBE V USLOVIYAKH SUSHCHESTVENNOY NEIZOTERMICHNOSTI]

A. I. Leont'yev et al. Mar. 1969 12 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), Jul.–Aug. 1968 p 99–104

(Contract NASw-1696)

(NASA-TT-F-12133) Avail: CFSTI CSCL 20D

The theoretical and experimental determination of entrance link of an annular tube containing an essentially nonisothermal subsonic gas flow is investigated. The experiments were conducted for enthalpy factors ranging from 0.08 to 0.8 and Reynolds numbers from $6.9 \cdot 10^3$ to $2.4 \cdot 10^5$. The test section was a

solid copper tube with an inside diameter of 18.5 mm and a wall thickness of 1.5 mm. An M-20 computer was used for the calculations. The velocity measurements agreed satisfactorily with theory. It was found that the entrance link increases considerably as the Reynolds number at the tube entrance increases, and that the cooling of the tube has relatively little effect on the length. Author

N69-19911 Michigan Univ., Ann Arbor.
SOME PROBLEMS INVOLVING PARTICLE-FLUID TWO-PHASE FLOW
Terry Lee Tranen (Ph.D. Thesis) 1968 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-13417

A statistical mechanics approach following Maxwell and Boltzmann is used to determine in a systematic manner continuum mass, momentum, and energy conservation equations for a particle-fluid two phase flow. The equations obtained include the effects of voidage, the fluid phase volume fraction, away from unity. Applications are considered of the equations to three problems: 1) determine solutions for the oscillating infinite flat plate and compare the solution to that for a pure fluid; 2) for small time determine a solution for a flat plate moved impulsively from rest, and indicate that for small times added mass and history contributions are of major importance; and 3) in the range of large Reynolds number [O(100)] consider the flow of a two phase fluid through a normal shock. Dissert. Abstr.

N69-19947 California Univ., Los Angeles.
UPPER BOUNDS ON THE TORQUE IN CYLINDRICAL COUETTE FLOW
Everett Clifford Nickerson (Ph.D. Thesis) 1968 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-12472

Upper bounds on the torque are derived for a fluid that is contained between two concentric rotating cylinders. Absolute upper bounds are obtained by requiring that the fluid satisfy the boundary conditions and the dissipation integral. Improved bounds are then found by requiring that the fluid satisfy continuity conditions. These bounds are in qualitative agreement with the data in that they reflect the asymptotic parameter dependence in the range of experimental data. Instability points are very close to experimentally determined values when the ratio of the inner radius to the outer radius is .5. Agreement becomes progressively worse, however, as that ratio approaches unity. By taking into account a more restrictive set of constraints, instability points are dramatically improved, and a qualitative feature of the more restrictive constraints results in a further reduction in the torque. Dissert. Abstr.

N69-19958 Minnesota Univ., Minneapolis.
MASS TRANSFER IN FLOWING SUSPENSIONS
Richard Ellis Collingham (Ph.D. Thesis) 1968 328 p
Avail: Univ. Microfilms: HC $14.85/Microfilm $4.20 Order No. 68-12249

The mass transfer characteristics are described of suspensions in tube flow at laminar tube Reynolds Numbers. Specifically, the experimental transfer of dissolved helium and oxygen in a neutrally buoyant suspension of polystyrene spheres in an aqueous solution was determined in tube flow. The presence of the particles significantly increased the dissolved gas transfer rates over a large range of particle rotation Reynolds Number (.1 to 2), particle concentration (.3% to 27.5%), particle diameter (50 to 100μ) and Schmidt Number (120 to 470). The shear field in laminar tube flow causes particles to rotate; the mass transfer augmentation was considered mainly a result of the small scale transverse mass convection associated with this particle spin. The overall augmentation is presented and correlated in diffusivity and Nusselt Number terms and a model describing the local diffusivity distribution within the tube is presented. Parallels to turbulent mass transfer were found. Dissert. Abstr.

N69-20030 Purdue Univ., Lafayette, Ind.
AN ANALYTICAL INVESTIGATION OF THE FLUID MECHANICS OF ROTATING FLOWS IN ROCKET MOTORS
David Jerry Norton (Ph.D. Thesis) 1968 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-12594

An analytical investigation was conducted to predict the effects of the fluid mechanics of rotating flow on the performance of solid propellant rocket motors. The governing equations for a rotating, inviscid, adiabatic, compressible flow were derived subject to the assumptions that radial velocities and their derivatives are negligible, and that the fluid is a thermally and calorically perfect gas. The equations governing the flow were reduced to a set of two nonlinear, ordinary differential equations. Results of the theory are presented for a number of particular rocket motors geometries and propellant shapes. The results indicate that the effects due to spin can be reduced by decreasing the nozzle contraction ratio, the molecular weight, and the propellant pressure exponent, and by increasing the flame temperature and specific heat ratio. Comparison with other theories for rotating flow in nozzles indicates that the assumptions of uniform contraction ratios of the streamlines and sonic velocity at the centerline of the throat plane are not valid assumptions for appreciable speeds of rotation. Dissert. Abstr.

N69-20059 Pennsylvania State Univ., University Park.
SOURCES OF SIGNAL NOISE IN FLUID AMPLIFIERS
John Carl Tamulis (Ph.D. Thesis) 1967 253 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.30 Order No. 68-12011

The basic sources of signal noise present in fluid amplifiers and resulting in unwanted signal disturbances detectable at the input and/or output terminals were investigated. The experimentation was conducted with simplified fluid amplifier geometries and a large scale, completely operational fluid amplifier. Data acquisition and collection were accomplished by using analog and digital techniques. The analog techniques resulted in experimentally measured power density spectra. Digital data acquisition and collection resulted in experimentally computed autocorrelation and crosscorrelation functions along with their respective spectra. A noise source was modeled for describing the power jet-knife edge interaction based on edgetone concepts. Another signal noise source was modeled for describing the noise source created at various power jet-amplifier port interfaces. Dissert. Abstr.

N69-20167# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Institut fuer Luftstrahlantriebe.
CALCULATION OF TWO-DIMENSIONAL INVISCID INCOMPRESSIBLE CASCADE-FLOW WITH A MODIFIED MARTENSEN-METHOD [ZUR BERECHNUNG DER EBENEN, REIBUNGSFREIEN, INKOMPRESSIBLEN GITTERSTROEMUNG MIT EINEM MODIFIZIERTEN MARTENSENVERFAHREN]
W. Geller Dec. 1968 60 p refs In GERMAN; ENGLISH summary
(DVL-806; DLR-FB-68-77) Avail: CFSTI

After a short description of the method, the numerical accuracy is investigated. Theoretical and experimental results for decelerating

cascades are compared. Except for the pressure distribution near the trailing edge and for cases of strong separation, the deviation between measurement and calculation can be explained by the inaccuracies of the particular experiment and by an incorrect assumption in calculating the circulation around profiles with rounded trailing edge. If these sources of errors are eliminated, the calculated pressure distributions are in good agreement with the measurements. Author

N69-20041 Michigan Univ., Ann Arbor.
AN EXPERIMENTAL INVESTIGATION OF THE COMBINED EFFECTS OF PRESSURE, TEMPERATURE, AND SHEAR STRESS UPON VISCOSITY
John David Novak (Ph.D. Thesis) 1968 213 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-13373

A capillary-type viscometer was developed to measure the viscosity of ten well defined fluids at pressures up to 80,000 psi, temperatures of 100, 210, and 300°F and shear stresses from 300 to 1.2×10^6 dynes/cm^2. The shear stress was varied via the pressure differential across the capillary which was independent of pressure level. Four interchangeable capillaries were employed to cover the shear stress range. The viscosity range examined was from 1.0 to 100,000 centipoise. Flow curves, viscosity-temperature curves, and viscosity-pressure curves are presented for all ten fluids as well as curves which compare the behavior of several fluids. A complete tabulation of the experimental data is also included. Data correlation techniques were investigated and interrelations among the fluids are discussed. Dissert. Abstr.

N69-20264# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION TO THE STUDY OF THE TRI-DIMENSIONAL IMCOMPRESSIBLE LAMINAR BOUNDARY-LAYER IN THE UN-STATIONARY REGIME [CONTRIBUTION A L'ETUDE DE LA COUCHE LIMITE TRIDIMENSIONNELLE LAMINAIRE INCOMPRESSIBLE EN REGIME INSTATIONNAIRE]
Radyadour Kh. Zeytounian [1968] 53 p refs In FRENCH; ENGLISH summary
(ONERA-NT-131 Avail: CFSTI

The problems of un-stationary incompressible laminar boundary-layers developing from rest are brought back to a same formalism by presenting the problem on a general point of view. We assume that the velocity of the external flow can be developed in series of $t^{1/2}$; it is then shown that the various quantities characterizing the flow in the unstationary boundary-layer can be determined by a power series expansion of $t^{1/2}$. A simple application is presented in the case of a circular cylinder. Author

N69-20274# Virginia Polytechnic Inst., Blacksburg. Dept. of Mechanical Engineering.
WALL SHEAR STRESS DIAGNOSTICS IN THREE-DIMENSIONAL TURBULENT BOUNDARY LAYERS
F. J. Pierce and D. H. Krommenhoek Sep. 1968 79 p refs
(Contract DAHC04-67-C-0008)
(AD-680973; ITR-2) Avail: CFSTI CSCL 20/4

Several of the more common means of inferring local wall shear values in two-dimensional turbulent boundary layer flows are reviewed and the suitability of these means for use in three-dimensional turbulent flows is discussed. A simple, floating element, direct force sensing device, corrected for pressure gradient effects, was used to measure the local wall shear stress in a strongly skewed, low-speed, incompressible three-dimensional turbulent boundary layer flow. These pressures corrected, direct force measurements are compared to wall shear stress values inferred by variations or adaptations of the two-dimensional techniques and/or devices reviewed. Author (TAB)

N69-20293# Aeronautical Research Council (Gt. Brit.).
THE EFFECT OF CHANGE IN AXIAL VELOCITY ON THE POTENTIAL FLOW IN CASCADES
M. R. A. Shalaan and J. H. Horlock 1968 23 p refs Supersedes ARC-28611
(ARC-R/M-3547; ARC-28611) Copyright. Avail: CFSTI; HMSO 10s 6d

An analysis is given for the potential flow through a cascade in which a change in axial velocity occurs. An approximate solution of the derived potential equation is obtained and applied first to a flat plate cascade and then to a cascade of blades with camber and thickness. In the former application Weinig's exact solution is used as a first approximation while in the latter application Schlichting's analysis is used as a basic solution and then modified to account for the change in axial velocity. Calculations demonstrate the effect of change in axial velocity on the cascade performance. Author (ESRO)

N69-20311# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
THE INFLUENCE OF GRADIENTS OF VELOCITY AND TEMPERATURE IN A GAS FLOW ON THE ACCURACY OF FLOW DIRECTION MEASUREMENT WITH A FIVE HOLE PROBE
Rolf Ulken 20 Sep. 1968 38 p refs In GERMAN; ENGLISH summary
(DLR-FB-68-65) Avail: CFSTI

A short survey was made on flow direction measurement with five-tube probes in gas flows, and the influence of gradients of velocity and temperature on the accuracy of this method of measurement is described. The probes were calibrated in a uniform parallel flow. If there were gradients in the flow field to be investigated, leading to different dynamic pressures on adjacent streamlines, an apparent angle of attack and an apparent flow velocity was obtained by using a probe calibrated in this way. These results can differ considerably from the real values. The influence of these gradients on the accuracy of flow direction measurement was calculated in dependence of angle of attack, velocity, and temperature. The theoretical considerations were confirmed by experimental investigations. Author

N69-20312# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
INTERPRETATION OF TURBULENCE MEASUREMENTS [INTERPRETATION DES MESURES DE TURBULENCE]
Robert Legendre 1968 23 p In FRENCH; ENGLISH summary
(ONERA-NT-138 Avail: CFSTI

A complete observation of water flowing at low speed is described, and the mechanism of formation of viscous vortices in a flow is outlined. This justifies the successive studies of isolated vortices, of vortex streets, and of multiple vortex streets. As a result of such an analysis it is possible to analyze the measurements with hot wires. Entropy turbulence and the creation of sound waves are briefly surveyed. Author

N69-20327# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF A FIXED SUBSONIC AND SUPERSONIC GAS FLOW IN A PLANE PRESSURE NOZZLE

N. A. Lukyanov Jan. 1968 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), no. 2, 1966 p 47-52
(AD-681059; FTD-HT-23-1235-67) Avail: CFSTI

A plane potential subsonic and supersonic flow of gas is analyzed without taking into account the viscosity and heat conduction. A particular solution, corresponding to the motion of a gas in a nozzle with a curvilinear sonic line, was obtained for the system of mixed elliptic-hyperbolic equations of motion in the potential plane. The accuracy of the simplifications used in the analysis was verified by exact calculations and experiments.
Author (TAB)

N69-20330# Harvard Univ., Cambridge, Mass. Engineering Sciences Lab.
THE CURRENT STATUS OF STATISTICAL MODELS IN KINETIC THEORY
D. G. M. Anderson, H. Baum, M. Krook Nov. 1968 13 p
(Grant NSF GK-65)
(TR-32) Avail: Issuing Activity

Some general approaches to the formulation of a hierarchy of statistical kinetic equations are described. Equations describing gases ranging in complexity from a simple gas with no internal degrees of freedom to a multi-component reacting mixture are presented.
Author

N69-20344# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
AN EXPERIMENTAL INVESTIGATION OF THE UNSTEADY FLOWS ABOUT SPHERES AND DISKS
Frederick W. Roos (Ph.D. Thesis) Dec. 1968 193 p refs
(Grant DA-ARO(D)-31-124-G711)
(AD-680917; Rept-01954-1-T; AROD-559:2-E) Avail: CFSTI CSCL 20/4

The various features of unsteady three-dimensional bluff body flow fields have been studied in a towing channel filled with glycerol-water mixtures and equipped with an air bearing supported model carriage. Steady drag coefficients for the sphere and disk agreed with existing data except for the disk in the range 100 < Re sub d < 1000 where C sub D is as much as 50% lower than previous results. Peak-to-peak moment coefficients developed on a disk are of the order of 0.007 for 100 < Re sub d < 500 at nondimensional frequencies of 0.10 < fd/U < 0.14. The sphere wake was seriously disturbed by the sting model support, however, the unsteady side force coefficient is of the order of 0.02 to 0.10 for 270 < Re sub d < 560. Flow visualization studies using hydrogen bubbles were used to relate the unsteady forces to the shedding of vortices in the wake.
Author (TAB)

N69-20362# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
LOW DENSITY HIGH TEMPERATURE GAS DYNAMICS Final Scientific Report, 1 Nov. 1967–31 Oct. 1968
Jean J. Smolderen and J. F. Wendt Nov. 1968 21 p refs
(Grant AF-EOAR-0019-68)
(AD-681197; AFOSR-69-0065TR) Avail: CFSTI CSCL 20/4

The modulated force probe technique was employed to determine the drag coefficients of spheres and cones in the transitional and near-free-molecule regimes at hypersonic Mach numbers. A free jet served as the flow field. Data scatter is very low; agreement with data and theories of other investigators appears good. The cone drag data extend, almost two orders of magnitude in Reynolds numbers, previously published information. No evidence of drag overshoot was found. A Mach 1.5 nozzle was designed for 10 microns Hg exit pressure and its measured performance agreed well with theoretical calculation. The nozzle was used to supply a rarefied flow field over a flat plate with a sharp leading edge. Surface pressures were measured and are in qualitative agreement with weak interaction theories at small values of viscous interaction parameter and with the BGK discrete-ordinate technique at large values of viscous interaction parameter. The present status and projected research program for electron beam fluorescence probe are discussed. Present development problems center around beam focussing.
Author (TAB)

N69-20353# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
NONSTEADY ONE DIMENSIONAL COMPRESSIBLE FLUID FLOW THROUGH ANISOTROPIC POROUS MEDIA
S. S. T. Fan and Yin-Chao Yen Nov. 1968 21 p refs
(AD-681211; CRREL-RR-256) Avail: CFSTI CSCL 20/4

The flow of a compressible fluid through a deep layer of a porous medium with non-uniform permeability was analyzed. The volumetric behavior of the fluid was described first by the perfect gas law, then by the van der Waals equation of state. Darcys law was assumed to be valid. For illustration, the model of air flowing through a deep bed of naturally compacted snow was used to carry out numerical computation. The permeability of snow was considered as a function of depth. The nonlinear partial differential equation obtained by combining the continuity equation with Darcys law was solved by finite difference technique. A time dependent exponential decay boundary condition was used which included the step-rise constant boundary condition as a limiting case. Pressure distributions in the porous medium calculated from the assumption of ideal gas and van der Waals gas were compared. The data were presented in dimensionless variables.
Author (TAB)

N69-20430# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RELAXATION PROCESSES IN SHOCK WAVES
E. V. Stupochenko, S. A. Losev, and A. I. Osipov Feb. 1968 443 p refs Transl. into ENGLISH from the book "Relaksatsionnye Protsessy v Udarnykh Volnakh" Moscow, 1965 p 1–484
(AD-681337; FTD-MT-24-199-67) Avail: CFSTI CSCL 20/4

The present state of experimental and theoretical investigations of relaxation processes taking place in shock waves in gases and air is described and analyzed. Particular attention is paid to physical aspects of relaxation phenomena and to elucidation of patterns in processes taking place in the establishment of statistical equilibrium with respect to various degrees of freedom. The first chapter deals with general problems and presents a qualitative description of the relaxation process and the fundamentals of experimental methods. The second deals with shock tubes as a means for generating and studying strong shock waves and related phenomena. Chapter three deals with the experimental methods used for investigating nonequilibrium phenomena taking place in shock waves. Chapter four is devoted to a theoretical analysis of relaxation processes and available experimental data. Chapter five deals with nonequilibrium phenomena taking place behind a shock front in air. Chapter six briefly outlines the gas flow properties in relaxation and contains a brief analysis of gaskinetic methods for deriving equations of equilibrium and relaxation hydrodynamics and methods of the thermodynamics of irreversible processes.
Author (TAB)

N69-20493# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
THE VELOCITY, PRESSURE AND TEMPERATURE DISTRIBUTIONS IN THE TURBULENT SUPERSONIC NEAR

WAKE BEHIND A TWO DIMENSIONAL WEDGE FLAT PLATE MODEL, PART 1 Final Report
Josef Rom, Yigal Kronzon, and Arnan Seginer Sep. 1968 80 p refs
(Contract F61052-67-C-0033)
(AD-681237; TAE-80-Pt-1) Avail: CFSTI CSCL 20/4

The flow field in the near wake behind a blunt two dimensional base in turbulent supersonic flow is investigated. The flow field is surveyed using total and static pressure probes, shielded thermocouple probes and photographed using shadow and oil pattern visualization techniques. Detailed surveys of pressure, Mach number and recovery temperature are presented for 7, 10 and 14 mm base height models at flow Mach number 2.25 and Reynolds number, based on model length of 1,500,000. Some results at flow Mach number 3.5 are included. The results do indicate a reasonably strong lip shock which is associated with the interaction of the separating boundary layer and the corner flow. Furthermore, qualitative indications on the flow pattern in the dead water zone and the rear stagnation point are presented. Author (TAB)

N69-20530# Avco-Everett Research Lab., Everett, Mass.
STRUCTURE OF THE LAMINAR ABLATING AIR-TEFLON BOUNDARY LAYER
Robert A. Greenberg, Nelson H. Kemp, and Kurt L. Wray Nov. 1968 75 p refs Submitted for publication
(Contract F04701-68-C-0036)
(AD-681152; AERL-RR-301; SAMSO-TR-68-313) Avail: CFSTI CSCL 20/4

Radiation profiles in an ablating flat plate air-teflon laminar boundary layer were studied both experimentally and theoretically. The experiments were conducted in a one atmosphere, 3000 - 6000K, subsonic free stream produced by an arc jet. Spatially resolved radiation profiles within the boundary layer were obtained in both the visible and infrared. The major radiation in the visible and near ultraviolet wavelengths was the CN violet. In the infrared, the major radiators were CO, CO2, NO and COF2. The theory which was developed to predict the structure included coupling of the heat and mass transfer at the Teflon surface. A partial equilibrium model for the teflon-air chemistry was utilized, which does not allow the formation of CF3 and CF4 within the boundary layer. For the selected wavelengths in the infrared the theory generally predicted quite well both the spatial location and magnitude of the peak radiation, and also predicted the integrated radiation across the layer to within a factor of two. For the selected wavelength in the visible, the radiation intensity, which comes from CN, is much larger than predicted, indicating that the CN is not in thermodynamic equilibrium. Author (TAB)

N69-20548# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMODYNAMIC AND STATISTICAL METHODS FOR THE INVESTIGATION OF ULTRASONIC CAVITATION
V. K. Makarov et al 11 Jan. 1968 19 p refs Transl. into ENGLISH from Akust. i Ultrazvuk (Ukrania), no. 1, 1966 p 5-21
(AD-681055; FTD-HT-23-1242-67) Avail: CFSTI CSCL 20/4

A theoretical analysis of ultrasonic cavitation was made and experiments were conducted on acoustical measurements under cavitation conditions. An equation for the critical radius of a gas nucleus forming in liquids under metastable thermodynamic conditions was obtained. An equation is also given for the total volume of gas nuclei formed during cavitation at a frequency of 20 Kc in the temperature range 10-60C, for different molal air contents dissolved in water. Experimental results showed that cavitation was highly dependent on the gas content of the liquid. Author (TAB)

N69-20551# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.
TESTS OF A VARIABLE SWEEP HYDROFOIL WITH CAVITATION AND VENTILATION Final Letter Report
John A. Mercier Jan. 1969 41 p refs
(Contract N600(19)62908)
(AD-681021; LR-1332) Avail: CFSTI CSCL 13/10

An experimental study of the performance of a variable sweep hydrofoil was carried out in the variable pressure circulating water channel under conditions of reduced ambient pressure. A hydrofoil with tapered planform and typical sub-cavitating sections in the high aspect ratio (AR) attitude was attached to a base ventilated strut in such a way that it could be rotated, thus changing foil sweep. The attack angle of the foil and strut system were adjustable. Measurements were made of the lift and drag acting on the foil and strut as a function of attack angle, sweep angle, depth of submergence and cavitation index for both steady foil position and with sweep and attack angles continuously varying. Still and motion picture records of some interesting flow phenomena were obtained. Author (TAB)

N69-20569# Massachusetts Inst. of Tech., Cambridge.
ON THE INITIAL VALUE PROBLEM FOR ROTATING STRATIFIED FLOW
Louis N. Howard and William L. Siegmann 1969 36 p Prepared in cooperation with Calif. Univ., Los Angeles and Johns Hopkins Univ.
(Contracts N00014-67-A-0204; Nonr-233(78))
(AD-681065) Avail: CFSTI CSCL 20/4

An investigation is made of some general properties of motions of a compressible fluid under the influence of a gravitational field. Motions (or time scales) for the dissipative effects of viscosity and heat condition are not important, and the motions are small deviations from a basic state of rigidly rotating hydrostatic equilibrium. It is assumed that the gravitational field is externally given, and is not itself affected by the motion. The mathematical model based on these hypotheses is the linear theory of rotating stratified non-dissipative flow. Author (TAB)

N69-20587# Naval Underwater Weapons Research and Engineering Station, Newport, R. I.
HEAT AND MOMENTUM TRANSPORT IN DILUTE POLYETHYLENE OXIDE SOLUTIONS
William A. McNally Dec. 1968 83 p refs
(AD-681011; NUWS-TR-44) Avail: CFSTI CSCL 20/4

The purpose of this investigation was to study the turbulent pipe flow of dilute aqueous solutions of polyethlene oxide. In particular, this investigation was concerned with measurement of polymer solution friction factors in hydraulically rough pipe and with measurement of heat transfer coefficients in smooth pipes. The data were used to draw inferences about the mechanism of polymeric friction reduction and to test the theories which have been put forth in the literature concerning the phenomenon. Pressure drop was measured in a fully rough pipe, as well as in two smooth pipes of different diameter, as a function of flow rate and polymer concentration. Temperature rise was measured for flow of polymer solutions through a steam heated section of pipe, again as a function of flow rate and polymer concentration. It was found that the heat transfer coefficients are reduced as substantially as the smooth wall friction factors for these solutions. Rough pipe friction factors were reduced relative to that of water by the presence of the polymer solute, but the fractional reduction was not as great as that observed for smooth pipes. These results were used to show that the most widely accepted hypothesis concerning the cause of this frictional reduction phenomenon, stabilization and

thickening of the viscous and transition sublayers, is probably incorrect. The influence of the polymer molecules is shown to extend beyond the viscous dominated wall layer. Author (TAB)

N69-20597# Aeronautical Research Council (Gt. Brit.)
CALCULATION METHODS FOR THREE-DIMENSIONAL TURBULENT BOUNDARY LAYERS
P. D. Smith (Ph.D. Thesis—London Univ. Nov. 1965) 1968 44 p refs Supersedes ARC-28586
(ARC-R/M-3523; ARC-28586) Avail: CFSTI; HMSO 19s

Five methods for the approximate solution of the momentum integral equations for the three-dimensional turbulent boundary layer are presented. These include the removal of the usual small cross-flow velocity restriction and the development of the streamwise shape parameter which is calculated by means of an extension of Head's entertainment hypothesis. The predictions of these theories and of those of a method due to Cooke are then compared with the results of a series of experiments with an apparatus designed to simulate the case of an infinite yawed wing. A considerable discrepancy is shown to exist between theory and experiment which is attributed either to the streamwise skin friction being inadequately represented by an expression derived from two-dimensional flow or possibly, if less likely, to the neglect of certain terms in the derivation of the streamwise momentum-integral equation. Author (ESRO)

N69-20610# National Physical Lab., Teddington (England). Aerodynamics Div.
MEASUREMENTS IN A THREE-DIMENSIONAL MIXING LAYER BETWEEN TWO GRAZING PERPENDICULAR STREAMS
J. E. Hackett and D. K. Cox 16 Oct. 1967 72 p refs
(NPL-AERO-1248; ARC-29544) Avail: CFSTI

The velocity component in the resultant direction of the two streams is constant through the layer; the profile perpendicular to this (the shear direction) has approximately an error function form. The ratio of the maximum shear stress to the square of the shear velocity difference is about 50% greater than in a two-dimensional layer. Author (ESRO)

N69-20617# Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
THE IMPORTANCE OF BOUNDARY CONDITIONS IN THE NUMERICAL TREATMENT OF HYPERBOLIC EQUATIONS
Gino Moretti Nov. 1968 41 p refs
(Contracts Nonr-839(34); Nonr-839(38); ARPA Order 529)
(AD-681365) Avail: CFSTI CSCL 20/4

Many of the existing computations of initial-and-boundary value problems in fluid mechanics suffer from unrealistic treatment of boundary points. Three categories of boundaries are briefly discussed: rigid walls, arbitrary boundaries of a computational region in a subsonic flow, and shock waves. An attempt is made to show in what sense the numerical treatment of such boundaries may be physically wrong and what can be done instead. Examples from the blunt body problem, the transonic flow in a nozzle, the incompressible inviscid flow past a circle, and the quasi-one-dimensional flow in a Laval nozzle, are shown. Author (TAB)

N69-20629# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.
HYDRODYNAMIC STABILITY OF AXI-SYMMETRIC INTERNAL FLOWS WITH FLEXIBLE BOUNDARIES. PART 1: FLOWS WITH WALL DAMPING. PART 2: FLOWS WITH LONGITUDINAL WALL DISPLACEMENT
Jack Werner Sep. 1968 32 p refs
(Grant AF-AFOSR-178-67)
(AD-681195; NYU-AA-68-15-Pts-1-2; AFOSR-68-2576) Avail: CFSTI CSCL 20/4

A set of algebraic equations was derived which provide criteria for the occurrence of hydrodynamic instability in two separate cases. The first case considered the effect of wall damping properties in tubes for which only radial oscillations are permitted to take place. The equations indicate that in some cases the presence of wall damping may actually allow instability to occur where it would not have without damping. In the second problem the tube walls were permitted to undergo longitudinal wall displacement. Again, instability criteria were derived. Author (TAB)

N69-20630# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.
THE GROWTH OF SELF-PRESERVING TURBULENT JETS AND WAKES
B. G. Newman Dec. 1968 22 p refs
(Grant DRB-G-9551-12)
(Rept-68-10) Avail: CFSTI

Self preserving wakes and jets in streaming flow have been analyzed using integral equations, one of which is a combination of the mean and turbulence energy equations. The methods used only the measured rate of growth for a jet with quiescent surroundings and are less empirical than earlier methods based on the effect of rate of shear in the main flow on the size of the large eddies which use also the measured growth of a small deficit wake. The predictions of rate of growth, apparent shearing stress and intermittency which incorporate Prandtl's assumption for the shearing stress and Townsend's theory for the intermittency are in best agreement with the measurements. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N69-19648# Forsvarets Forskningsanstalt, Stockholm (Sweden).
TELESEISMIC RELATIVE LOCATION OF CLOSELY SPACED EPICENTERS
K. Kogeus Sep. 1968 48 p refs
(FOA-4-4370) Avail: CFSTI

A method to determine relative locations of closely spaced epicenters from teleseismic readings is defined. The method was tested on known Bikini events and applied to some events in Kazakhstan during 1965, 1966 and 1967. Statistical confidence measures are computed and sources of bias are discussed. Author (NSA)

N69-19649*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.
GLOBAL OBSERVATIONS ON THE THERMAL BALANCE OF THE NIGHTTIME PROTONOSPHERE
K. K. Mahajan and L. H.Race Dec. 1968 26 p refs
(NASA-TM-X-63459; X-621-68-506) Avail: CFSTI CSCL 04A

Alouette 2 electrostatic probe measurements of the nighttime electron temperature (T_e) and concentration (N_e) in the height range 2500 ± 500 Km are presented on global basis (−60 to +60

geomagnetic latitude). The major feature of the protonosphere at this altitude is an electron temperature trough of the order of 1800°K at the low latitudes, increasing sharply to over 3000°K at the middle latitudes. The electron concentration exhibits a pair of maxima at about 30° north and south with values ranging from 4×10^3/cc in fall to 8×10^3/cc in local summer. No definitive seasonal dependence is apparent in T_e. Comparison of the present Alouette 2 measurements with nearly simultaneous measurements on Explorer 22 during summer 1966 reveal a field aligned positive temperature gradient in T_e. Typical gradients at 1000 Kilometers are 0.5°/Km on the 35° field line and 1.0°/Km on the 50° field line. These gradients are consistent with the thermal energy stored in the nocturnal protonosphere and therefore no external source of heat is required to explain the observations. Author

N69-19680# Institut Royal Météorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS [OBSERVATIONS GEOPHYSIQUES] Monthly Bulletin, Oct. 1968
1968 39 p In FRENCH and DUTCH
Avail: CFSTI

Data are given from the geophysical observatories in Belgium related to: geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays. ESRO

N69-19679# Danish Meteorological Inst., Charlottenlund.
ON THE NATURALLY OCCURRING ELECTROMAGNETIC NOISE CALLED AURORAL HISS
T. Stockfelt Jorgensen Sep. 1968 69 p refs
(Contracts NAS5-3093; AF 61(052)-298; AF 61(052)-652; AF 61(052)-735; Grant NSF-GA-214)
(NASA-CR-100357) Avail: CFSTI

A wideband electromagnetic noise known as auroral hiss is observed at very low and low frequencies at ground-based stations and on satellites at high magnetic latitudes. This noise is shown to be correlated to various geophysical phenomena as aurora, magnetic disturbances, sporadic E layers and absorption of cosmic radio waves. The correlations indicate a relationship between fluxes of low-energy electrons in the high latitude magnetosphere and generation of hiss. A direct correlation between hiss and low-energy electrons is observed from the Injun 3 satellite. Observations of hiss from the ground and in space show that hiss is generated in the polar regions of the magnetosphere. The low-latitude boundary of these hiss zones seems to be consistent with the low-latitude boundary of the auroral oval. A model for a region in space in which auroral hiss is believed to be generated is discussed, and it is shown that auroral hiss may be generated by incoherent Cerenkov radiation from electrons with energies of the order of 1 keV. Author (ESRO)

N69-19681# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
THE CAPTURE OF SMALL IONS BY PARTICLES
T. P. Burke (Dublin Univ. Coll.), and G. Dalu Consiglio Nazl. delle Ric. May 1968 12 p refs Presented at the 4th Intern. Conf. on the Universal Aspects of Atmospheric Elec., Tokyo, 12–18 May 1968 Submitted for publication
(CENFAM-RDP-22) Avail: CFSTI

The electrical conductivity of the air decreases notably in the presence of any type of aerosol. The possible causes of this variation were investigated in controlled conditions, using artificial fog and condensation nuclei. From the results it is clear that the decrease in small ion concentration is due to the greater capture efficiency of the droplets and particles. Author (ESRO)

N69-19686# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
PROPOSITION OF A PROGRAM OF SPACE RESEARCH [PROPOSTA DI PROGRAMMA DI RICERCHE D'INTERESSE SPAZIALE]
Consiglio Nazl. delle Ric. Jun. 1967 26 p In ITALIAN Submitted for publication
(CENFAM-RDP-17) Avail: CFSTI

The Centro Nazionale di Fisica dell'Atmosfera e Meteorologia has presented a research program for the following projects: Multistation radar system for study of meteoroids and upper atmosphere, research on polar auroras and on magnetosphere, sounding rocket projects for the exploration of atmosphere between 30 and 80 km. The program is illustrated with cost estimates related to the various projects. ESRO

N69-19687# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
LOW THERMOSPHERE TEMPERATURE MEASUREMENT WITH SODIUM-CLOUD METHOD [MISURA DELLA TEMPERATURA NELLA BASSA TERMOSFERA COL METODO DELLA NUBE DI SODIO]
F. Pellegrini and D. Ventura Consiglio Nazl. delle Ric. May 1967 13 p refs Submitted for publication
(CENFAM-RDP-15) Avail: CFSTI

The sodium cloud method allows the measurement of the temperature and the density of the low thermosphere by use of optical measurements. The sodium emission is the doublet D_1, D_2 and by measuring this spectrum with a spectrograph it is possible to find out the temperature of the sodium and therefore the temperature of the atmosphere. The method is discussed theoretically and some results are given. ESRO

N69-19688# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
A STATISTICAL INVESTIGATION ON POLAR AURORAS
M. Giorgi, G. P. Gregori, and C. Valenti Consiglio Nazl. delle Ric. Feb. 1967 30 p refs Presented at the Inter-Union Symp. on Solar-Terrest. Phys., Belgrade, 1966 Submitted for publication
(CENFAM-RDP-10) Avail: CFSTI

The magnetosphere depends on the astronomical orientation of the geomagnetic field with respect to the solar wind. The statistical distribution of polar auroras must therefore depend on the orientation of the geomagnetic field with respect to the ecliptic plane. This peculiar feature of auroras that is called auroral astronomical geometry is investigated and preliminary results are given concerning a limited set of pre-IGY auroras. The criteria chosen to prepare the auroral collection are also briefly summarized. The results conform to the hypothesis of the auroral origin from the magnetospheric neutral sheet. Auroral particles are found to impinge over the earth with low angles with respect to the ecliptic plane ($\leq 40°$). Only in a 4-hours interval around midnight they are found to impinge with angles up to 70°. Definite evidence of these facts requires further investigation with a larger amount of data. A complex code is prepared for recording the morphological features of each aurora, namely: standard information, movement, intensity, color, sunlight, illumination, period of pulsation, location in the sky among stars and planets, time evolution, duration and general features of the auroral display. It is well known that the auroral morphology affects auroral heights and latitudes, etc.; presumably it should also affect its astronomical geometry, which will be investigated later. The code is extensively described in the appendix. Author (ESRO)

N69-19689# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
INVESTIGATIONS ON POLAR AURORAS AND GEOMAGNETISM
Giovanni P. Gregori Centro Nazl. delle Ric. Mar. 1968 13 p Presented at the 11th COSPAR Plenary Meeting, Tokyo, 9–21 May 1968 Submitted for publication
(CENFAM-RDP-21-E) Avail: CFSTI

Space research activity in 1967 at Centro Nazionale di Fisica dell Atmosfera e Meteorologia (CENFAM) is briefly illustrated; programs for 1968-1969 are outlined. ESRO

N69-19691# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
SPACE RESEARCH AT CENFAM DURING 1966 AND 1967-68
Centro Nazl. delle Ric. May 1967 7 p Presented at the 10th COSPAR Plenary Meeting, London, 24–29 Jul. 1968 Submitted for publication
(CENFAM-RDP-13-E) Avail: CFSTI

Space research activity in 1966 at Centro Nazionale di Fisica dell' Atmosfera e Meteorologia (CENFAM) is briefly illustrated; programs for 1967–68 are also outlined. ESRO

N69-19767# Institut Royal Météorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS [OBSERVATIONS GEOPHYSIQUES] Monthly Bulletin, Aug. 1968
1968 48 p In FRENCH and DUTCH
Avail: CFSTI

Data are given from the geophysical observatories in Belgium related to: geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays. ESRO

N69-19769*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A THEORY OF THERMOSPHERIC DYNAMICS. PART 1: DIURNAL AND SOLAR CYCLE VARIATIONS
H. Volland Dec. 1968 39 p refs
(NASA-TM-X-63458; X-621-68-503) Avail: CFSTI CSCL 04A

It is shown that the diurnal density and temperature variation within the thermosphere is generated not only by solar EUV heat input but also by a tidal wave from the lower atmosphere which penetrates into the thermosphere and predominates the diurnal variations below 250 km altitude. Assuming a tidal wave from below which is independent of solar activity and assuming solar EUV heat input to be proportional to the solar activity index $F_{10.7}$, the observed diurnal density variation and its dependence on solar activity can be explained and reproduced quantitatively with help of a two dimensional model between 100 and 400 km height. The calculated density agrees with the Jacchia model above 300 km and with observations made by Priester, May, King–Hele, Taeusch and by Marov below 250 km. Author

N69-19787# Dominion Observatory, Ottawa (Ontario).
NON-RANDOM INFLUENCE OF EXTERNAL SOURCES ON A GEOMAGNETIC INDUCTION ANOMALY IN NORTHERN PART OF GREENLAND
J. Wahjelm Charlottenlund, Denmark Danish Meteorol. Inst. Jul. 1968 27 p refs Sponsored in part by Natl. Res. Council of Can.
(R-6) Avail: CFSTI

Various authors have shown that vectors representing changes in the geomagnetic field often tend to lie in or close to a plane. W. D. Parkinson has observed that for coastal observatories this plane almost invariably tilts upward towards the nearest deep ocean. In the present paper it is demonstrated that a similar effect exists in Greenland at Station Nord situated close to the Polar Basin. Furthermore it is shown that the orientation of the preferred plane depends not only on the frequency spectrum of the geomagnetic variations, but also on the directional and non-random characteristics of the external sources. At station Nord these non-random characteristics lead to a diurnal variation in the orientation of the preferred plane which amounts to as much as 15° in tilt and 40° in azimuth. The concept of a 'magnetic activity ellipsoid' is introduced in section 2 as a useful technique for the analysis of changes in the magnetic field. This method is not limited to the investigation of induction effects and might prove useful in other cases where polarization originating from the configuration of the sources can be expected. Author (ESRO)

N69-19803 Illinois Univ., Urbana.
EFFECTS OF COMPRESSIBILITY, PERMEABILITY AND VOID RATIO VARIATIONS ON THE CLASSICAL THEORY OF CONSOLIDATION
John Young Lai (Ph.D. Thesis) 1968 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-12146

The average degree of consolidation for a layer of clay is obtained using the relationships between coefficient of compressibility and effective stress. Unlike in the classical theory, this quantity is different from the average degree of excess pore pressure dissipation. Solutions of the consolidation equation for a clay layer (1) under a total load that is applied instantaneously, (2) subjected to a constant rate of loading and (3) during and after its deposition at a constant rate were obtained numerically by using a predictor-corrector modification of the standard Crank–Nicolson procedure. A computer program coded in FORTRAN was developed to obtain these solutions which are summarized and presented in graphical form. The computer program is capable of handling arbitrary rates but only the results for constant rate of loading and deposition are presented. Dissert. Abstr.

N69-19848# Library of Congress, Washington, D. C. Aerospace Technology Div.
BALL LIGHTNING AND ELECTROMAGNETIC RADIATION FROM LINEAR LIGHTNING DISCHARGES
Jordan Randjelovic *In its* Foreign Sci. Bull., Vol. 5, No. 2 Feb. 1969 p 65–70 refs (See N69-19843 09-34)
Avail: CFSTI

A hypothesis of P. L. Kapitsa that ball lightning phenomena are due to microwaves generated by lightning is reviewed. Results of an experimental study of the microwave radiation are presented, and the instrumentation used is briefly discussed. Author

N69-19849# Library of Congress, Washington, D. C. Aerospace Technology Div.
SATELLITE GEODESY IN THE USSR
Daniel W. Michaels *In its* Foreign Sci. Bull., Vol. 5, No. 2 Feb. 1969 p 71–86 refs (See N69-19843 09-34)
Avail: CFSTI

A description is provided of the basic techniques developed in the USSR in satellite geodesy, photometric observations of satellites, and some applications of satellites in geophysical research. The technical specifications of the standard satellite cameras are given. The discussion of satellite geodesy is based primarily on a survey published on the occasion of the 10th anniversary of the Soviet space program. Author

N69-19860*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RADAR BACKSCATTER AND ROCKET PROBE MEASUREMENTS OF ELECTRON TEMPERATURE ABOVE ARECIBO

L. H. Brace, H. C. Carlson and K. K. Mahajan Dec. 1968 11 p refs

(NASA-TM-X-63477; X-621-68-482) Avail: CFSTI CSCL 04A

The backscatter and probe measurements were correlated to uncover and investigate any systematic differences between the two methods. Double-pulse radar observations were taken before and after each of the two rocket flights and an additional observation was centered on the time of launch of the night flight. At altitudes below 180 km and above 240 km for the day flight, the measurements agreed to within 5%. Agreement above 286 km for the night flight is within 10%, with the radar values systematically lower. The difference evident only at night could not be attributed with certainty to either a variability of the ionosphere or a real experimental error in either or both methods. Conflicting results of similar intercomparison experiments are presented and examined. K.R.G.

N69-19876 Michigan University, Ann Arbor.

THE COOLING OF THE PROTONOSPHERE

Pierre Bauer (Ph.D. Thesis) 1968 121 p

Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-13275

The continuity, momentum, and heat equations are derived from the Boltzmann equation for the special conditions of the protonospheric plasma. The confinement of the photonospheric plasma by the magnetic field reduces the study to a one-dimensional problem along the magnetic field. This set of basic time-dependent equations is solved along three geomagnetic mid-latitude field lines from an altitude of 1000 km in one hemisphere to the same altitude in the conjugate hemisphere. The geomagnetic latitude of the field lines refers to the geomagnetic latitude of the base of these lines at 1000 km. The boundary conditions at 1000 km are obtained from Explorer XXII measurements. The solution yields the temperature and density profiles along the three field lines as a function of time. Energy and particle fluxes are also deduced from the numerical solution. Due to the low collision frequencies of charged particles with neutral ones, the charged particle distribution is always close to the instantaneous diffusive equilibrium. Dissert. Abstr.

N69-19889# Electro-Optical Systems, Inc., Pasadena, Calif.

STUDY TO DEVELOP A TECHNIQUE FOR MEASUREMENT OF HIGH ALTITUDE OZONE PARAMETERS Final Report

J. A. Duardo 12 Nov. 1968 227 p refs

(Contract NAS12-137)

(NASA-CR-86127; EOS-7087-FINAL) Avail: CFSTI CSCL 04A

Results are presented of a two-year study and research effort to evaluate optical techniques for monitoring the atmospheric ozone distributions on a continuous basis and on a worldwide scale. The conclusions of an analysis of laser techniques for remote probing of the atmosphere for ozone are given, along with a recommendation for further study of one specific technique involving ground-based lasers. The major emphasis is placed on a detailed documentation of the practicality of a passive technique for monitoring ozone from satellites, which relies on the use of the sun as a light source for absorption measurements through the earth's atmosphere. The vehicle chosen for this proposed measurement is the Nimbus meteorological satellite, whose near polar, sun-synchronous orbits would allow excellent coverage of the ozone distributions to be obtained at high latitudes in both hemispheres. The importance of this type of coverage, from the point of view of understanding the complex polar atmospheric circulation patterns, is also treated in some detail. Author

N69-19891*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FREQUENCY SHIFTS OBSERVED IN THE ALOUETTE 2 CYCLOTRON HARMONIC PLASMA RESONANCES

Robert F. Benson Feb. 1969 16 p refs Submitted for publication

(NASA-TM-X-63483; X-615-69-76) Avail: CFSTI CSCL 04A

The cyclotron harmonic plasma resonances observed by Alouette II were investigated using a technique that yielded frequency measurements with an accuracy of the order of 1 kc/s. The resonances observed near f_H and $2f_H$ experience frequency shifts of the order of +2% and +0.5%, respectively. The resonances observed above f_T approach the true frequency values of nf_H as n increases; beyond about n=5 the observed cyclotron harmonic resonant frequencies are consistent with a single value of f_H which agrees with model magnetic field calculations within the estimated 0.2% reliability of this field. A comparison of the earlier Alouette I results with the present Alouette II result indicates that the bulk of the original excitation volume associated with the higher cyclotron harmonic resonances is confined to a region considerably less than one antenna length in radius from the antenna, that the size of this region decreases with increasing harmonic number n, and that it increases significantly as the radiating antenna becomes parallel to the direction of the earth's magnetic field. Author

N69-19904# Belgian Royal Observatory, Uccle.

NATIONAL REPORT ON SEISMOLOGY AND PHYSICS OF THE EARTH'S INTERIOR, 1960–1967 [RAPPORT NATIONAL CONCERNANT LA SEISMOLOGIE ET LA PHYSIQUE DE L'INTERIEUR DE LA TERRE, 1960-1967]

P. Melchior and J. M. van Gils [1967] 16 p refs In FRENCH Presented at the 14th IGGU Gen. Assembly, Zurich, Sep. 1967 Commun. Ser. B, No. 19 Geophys. Seri. No. 81

Avail: CFSTI

A list of seismic stations in Belgium is given along with their geographical coordinates and instrumental equipment and the seismic activity from 1960 to 1967 is briefly described. ESRO

N69-19917 Pennsylvania State Univ., University Park.

A MODEL OF VERTICAL TURBULENT TRANSPORT IN THE ATMOSPHERE

Steven Rogers Hanna (Ph.D. Thesis) 1967 78 p

Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-11988

A universal scheme of estimation for K, the vertical eddy diffusivity coefficient in the atmosphere is developed. Dimensional reasoning was used to hypothesize that the mixing efficiency K must depend upon the physical parameters that describe the energy spectrum of the vertical fluctuations of the wind velocity: the mean eddy size and the amounts of turbulent energy carried by the eddies of various sizes. More specifically, the vertical velocity spectrum may be completely described by three parameters: (1) ϵ, the rate of dissipation of turbulent energy per unit mass; (2) σ_w, the standard deviation of the fluctuations of the vertical wind; and (3) k_m, the wave number of the eddies that carry the maximum amount of vertical turbulent energy. Specific atmospheric measurements were used to establish empirical formula for k_m, the wave number of the peak of the vertical velocity spectrum. The universality within the planetary boundary layer of the theory indicates that this theory is superior to the inconsistent interpolation formulas and empirical schemes that have been used in the past. The basic hypotheses should be tested next in turbulent regions of the atmosphere above the planetary boundary layer, to assert its complete universality. Dissert. Abstr.

N69-19921*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DOCUMENTATION OF EXPLORER 32 ELECTRON TEMPERATURE MEASUREMENTS USED IN COMPARISONS WITH BACKSCATTER MEASUREMENTS AT JICAMARCA
L. H. Brace and P. L. Dyson Nov. 1968 25 p refs
(NASA-TM-X-63476; X-621-68-469) Avail: CFSTI CSCL 04A

A series of Explorer 32 satellite passes over Jicamarca provided direct measurements of electron temperature that disagree significantly with those derived from radar backscatter data. The Explorer 32 electrostatic probe experiments are briefly described; experimental data from which the satellite values of electron temperature were derived are presented; the analysis procedure is outlined; and the known sources of random and systematic error are discussed. It is concluded that the excellent quality of the data, the linearity of the $\log_{10} I_e$ plots over nearly two decades of electron current, and the agreement between the values derived from the two independent probe experiments make it difficult to understand how the probe-derived temperatures could be in error by a factor large enough to explain the disagreement with backscatter data.
Author

N69-19931 Wisconsin Univ., Madison.
VARIATIONS OF THE EARTH'S RADIATION BUDGET
Thomas Henry Vonder Haar (Ph.D. Thesis) 1968 126 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-9144

More than 40 months of radiometric measurements from the first generation meteorological satellites are used to describe the radiation budget of the earth-atmosphere system. The geographical and temporal variation of the energy exchange between the earth and space is examined with the aid of mean annual and seasonal maps, zonal averages and mean global values. The study includes a complete error analysis and the satellite measurements compare well with the few available independent observations.
Dissert. Abstr.

N69-19936*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPARISONS BETWEEN TOPSIDE AND GROUND-BASED SOUNDINGS
John E. Jackson Mar. 1969 40 p refs
(NASA-TM-X-63474; X-615-69-79) Avail: CFSTI CSCL 04A

Past observations, indicating that electron density profiles derived from topside ionograms have a tendency to be slightly too low, are reviewed and discussed. This problem is then examined in the light of more recent and better controlled experiments in which vertical electron density profiles were obtained essentially simultaneously by topside and ground-based soundings. These new measurements confirmed past observations and indicated that the error had a tendency to increase with satellite altitude. From a study of the ground echoes, which are often seen on topside ionograms, it is shown that the above discrepancies can be partially attributed to systematic errors (0 to +30 km) in the topside ionogram height markers.
Author

N69-19978*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A REVIEW OF THE THEORIES CONCERNING THE EQUATORIAL F2 REGION IONOSPHERE
Richard A. Goldberg Mar. 1969 36 p refs Submitted for publication
(NASA-TM-X-63484; X-615-69-77) Avail: CFSTI CSCL 04A

The most characteristic feature of the equatorial F region ionosphere is the equatorial geomagnetic anomaly. This phenomenon has been known for nearly 30 years from bottomside measurements, but only recently have topside Alouette data provided the overall description to permit development of theoretical models. It appears that the major contribution to this effect lies in the interaction of the ionosphere with the earth's magnetic field via mechanisms causing drifts and currents. However, other theories have considered control due principally to production, loss and temperature effects. This paper reviews relevant theoretical analyses and compares the theoretical predictions with data available from the Alouette I topside sounder.
Author

N69-19988* Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
GEOPHYSICAL RESEARCH
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 47–49 refs
(See N69-19981 09-34)
(Grants NGR-22-009-131; NGR-22-009-114)
Avail: CFSTI CSCL 04A

Optical radar experiments were performed in Alaska and Sweden to observe the mesospheric aerosol content during noctilucent cloud (NLC) displays. These preliminary experiments provided measurements of the average scattering cross section of stratifications near 70 km. The presence of a layer at 70 km, well below the height commonly found for noctilucent clouds, was taken as an indication that measurable processes involving a wide range of mesospheric heights might be involved. In order to acquire further evidence, a new series of experiments was carried out near Oslo, Norway. The data obtained in these experiments also showed an increase in the 60–70 km signal with a maximum in the altitude interval 66–68 km; the enchanced signal was more evident for nights during which noctilucent clouds were present. The data are statistically relevant and point to an average backscattering optical thickness for the 2-km interval from 66–68 km of $(5.6 \pm 1.6) \times 10^{-8}$ during nights when NLC were visually observed and of $(2.8 \pm 1.5) \times 10^{-8}$ for nights when NLC were not visible. It should be possible to relate the presence of dust in the mesosphere to available sources and transport mechanisms. If the particles are very small, updrafts of relatively small amplitude could lift them from the lower stratosphere to equilibrium levels in the mesosphere.
Author

N69-20042 New York Univ., N. Y.
NEUTRONS PRODUCED IN THE EARTH'S ATMOSPHERE BY THE COSMIC RADIATION
William George Sandie (Ph.D. Thesis) 1968 241 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 68-13141

Balloon borne experiments designed to measure the fast neutron flux in the atmosphere were carried out during the past solar minimum, 1965, from Ft. Churchill, Manitoba and from South Saint Paul, Minnesota. A measurement of the latitude variation of both fast and slow neutrons was made in an aircraft circumnavigating the earth from geographic pole to pole at two almost opposite longitudes. Both fast and slow neutron counting rates display an increase of about 600% from equator to pole at 245 gm/cm^2. The differential flux of neutrons in the energy range 1–10 Mev is compared with that obtained in balloon borne measurements with the same detection system and with the work of others. An estimate of the effect of the aircraft environment on the measured flux is obtained.
Dissert. Abstr.

N69-20062# Institut Royal Météorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS [OBSERVATIONS GEOPHYSIQUES] Monthly Bulletin, Sep. 1968
Sep. 1968 44 p In FRENCH and DUTCH
Avail: CFSTI

Data are given from the geophysical observatories in Belgium related to: geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays. ESRO

N69-20074*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROVISIONAL HOURLY VALUES OF EQUATORIAL Dst FOR 1964, 1965, 1966 AND 1967
M. Sugiura and S. J. Cain Feb. 1969 62 p refs
(NASA-TM-X-63480; X-612-69-20) Avail: CFSTI CSCL 08N

Monthly tables of the hourly values are presented, providing a magnetic activity index as a function of universal time. Author

N69-20095 Michigan Univ., Ann Arbor.
VERTICAL GEOELECTRIC EXPLORATION UTILIZING NONUNIFORM TRANSMISSION LINE THEORY
William Don Becher (Ph.D. Thesis) 1968 200 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-13276

A new method for modeling the earth as a semi-infinite nonuniform transmission line is described. Surface electric and magnetic fields produced by either magnetotelluric or line current sources are shown to correspond to transmission line input voltage and current. The electrical properties of the earth are then analytically characterized from a knowledge of the surface fields, an improvement over the present methods which require the comparison of measured data with a catalog of theoretical results based on anticipated variations. Two models are used: the lossless line which is an accurate representation at the higher frequencies and the lossy line which is an accurate representation at the lower frequencies. The lossless model is examined in detail and an analytical procedure developed for determining the permittivity variation, followed by implementation on the IBM 7090 digital computer. The lossy model is treated by the same methods after applying an $s = p^2$ transformation to the complex frequency variable. The lossy model leads to the conductivity variation. In order to apply this theory it is necessary to represent the surface field data as a rational function of frequency for the lossless model and as a nonrational function of frequency for the lossy model. These representations are accomplished by suitably modifying a digital computer program originally developed to minimize the error between empirical data and analytical representations. Examples for the magnetotelluric and current line sources are given to confirm the numerical techniques. Dissert. Abstr.

N69-20103 Washington Univ., Seattle.
PROFILES OF WIND SPEED, TEMPERATURE AND HUMIDITY OVER THE SEA
Clayton Arvid Paulson (Ph.D. Thesis) 1967 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-9319

One hundred eighteen sets of simultaneous profiles of wind speed, temperature, and humidity are obtained from data collected over the Indian Ocean. Measurements were made at heights 1 to 8 m above the sea by use of instrumentation mounted on a buoy designed especially for the purpose. The effects on the profile measurements of the motions of the buoy are analyzed and concluded to be negligible, at least insofar as they relate to the computation of turbulent fluxes. The sampling error of the profile measurement system is examined and correction procedure is devised. The over-all random errors in the measurements after correction for sampling error are estimated to be 3 cm/sec in the wind, .009 deg C in the temperature and .03 gm/kg in the specific humidity. Dissert. Abstr.

N69-20135# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
THE GENERAL SOLUTION OF A WEDGE ON AN ELASTIC FOUNDATION
Donald E. Nevel Nov. 1968 21 p refs
(AD-680901; CRREL-RR-247) Avail: CFSTI CSCL 8/13

The differential equation, the fourth derivative of y with respect to x + 2/x x the third derivative of y with respect to x + y = 0 describes the deflection of a wedge on an elastic foundation. The equation is solved by means of contour integration. TAB

N69-20140# Finnish Meteorological Inst., Helsinki.
MAGNETIC CHARTS OF FINLAND FOR 1965
C. Suckadorff, P. Serson (Dominion Obs.), and V. Reesaenen (Geol. Surv. of Finland) 1968 24 p refs *Its* Studies in Earth Magnetism No. 21
Avail: CFSTI

This publication and the attached charts are presented to give the best possible estimates, based on all the data now available, for the components of the magnetic field in Finland—the vertical intensity *Z*, the horizontal intensity *H*, the declination *D*, and the total intensity *F*. Except for the eastern border areas of Finland, the present charts have been based on the results of a new three-component aeromagnetic survey. This was part of a Scandinavian Survey carried out by the Dominion Observatory of Canada in 1965. Author

N69-20148# Royal Aircraft Establishment, Farnborough (England).
GEOPHYSICAL RESEARCH BASED ON VISUAL OBSERVATIONS OF SATELLITES
D. G. King-Hele and D. E. Smith (Radio and Space Res. Sta.) Jul. 1968 12 p refs Presented at the UN Conf. on the Exploration and Peaceful Uses of Outer Space, Vienna, Aug. 1968
(RAE-TM-SPACE-111) Avail: CFSTI

A branch of space research that can be pursued at little expense by countries with no satellites of their own is described. There are now over 1000 satellites in orbit about the earth, and about 200 of these are bright enough to be seen with binoculars of quite low power. Volunteer observers, using stopwatches and binoculars, can make observations of these satellites with an accuracy of 1 to 2 minutes of arc in direction and 0.1 second in time. These observations from all parts of the world can be used to determine the satellite's orbit. The analysis of satellite orbits can then be used to study atmospheric density at heights between 150 and 1500 km, variations in air density correlated with solar activity, and the rotational speed of the upper atmosphere. The practical problems faced by a country wishing to start such work are discussed. It is suggested that the best policy for countries intending to start such work is to co-operate with existing prediction and computing centers. Author

N69-20149# Danish Meteorological Inst., Charlottenlund.
POLAR CAP EMISSIONS
K. Lassen Oct. 1968 18 p refs Presented at the Advan. Study Inst. on Aurora and Airglow, As, Norway, 29 Jul.–9 Aug. 1968
(R-8) Avail: CFSTI

A review is given of the morphology of some optical emissions which are generally classified as aureras and which are typically occurring over the polar cap. Two main groups of aureral emissions are described: the discrete polar cap auroras and the polar-glow aurora. Author

N69-20174# Library of Congress, Washington, D. C. Aerospace Technology Div.
MODIFICATION OF THE IONOSPHERE Surveys of Foreign Scientific and Technical Literature
Daniel W. Michaels Dec. 1968 72 p refs
(AD-680983; ATD-69-11-101-1) Avail: CFSTI CSCL 4/1

Experiments in ionospheric modification, i.e., the introduction of chemical or radioactive agents into the ionosphere for the purpose of altering electron concentrations and thus ionization levels, have been conducted by the USSR, the US, and Britain in order to develop methods of ensuring communications reliability of friendly forces and disrupting enemy communications in the event of war. Primary attention in this report is focused on Soviet interest in the single most important such experiment, namely, the study of the effects of a nuclear burst at a given height on radar and radio-wave propagation characteristics. Other non-nuclear, but germane, experiments as, for example, investigations of ray paths in artificially created ionized clouds, are also discussed. Author (TAB)

N69-20182# Pennsylvania State Univ., University Park.
STRUCTURE OF WIND AND TEMPERATURE AT ROUND HILL, SOUTH DARTMOUTH, MASSACHUSETTS Final Report, Jul. 1967–Jul. 1968
Hans A. Panofsky, Roger A. Pielke, and Elizabeth V. Mares Oct. 1968 50 p refs
(Grant DA-AMC-28-043-68-G2)
(AD-680911; ECOM-68G2-F) Avail: CFSTI CSCL 4/1

Fluctuations of temperature and wind components at South Dartmouth, Mass. are analyzed. Temperature spectra and cospectra of stress and heat flux obey similarity theory; those of the horizontal wind components do not. Normalized cospectra of heat flux and stress are the same. New estimates of the universal constant in the inertial range are made. Estimation procedures for spectra and cospectra are presented. Coherence between winds and temperatures and wind components at different levels obey simple patterns. The time delay between levels is greater for wind direction than speed. Author (TAB)

N69-20183*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE REDUCTION OF TOPSIDE IONOGRAMS TO ELECTRON DENSITY PROFILES
J. E. Jackson 25 Feb. 1969 62 p refs Submitted for publication
(NASA-TM-X-63485; X-615-69-78) Avail: CFSTI CSCL 04A

The principles of the ionosonde technique are reviewed with emphasis on the satellite version topside soundings. The lamination method, developed initially for analyzing ionograms obtained with ground-based ionosondes, is used to calculate the electron density N vs. true height h in the topside ionosphere after a number of refinements are introduced. These refinements are required because the *extraordinary* wave data must be used to obtain N (h) profiles from topside ionograms, and because these data are very sensitive to the magnetic field variation over the great altitude range of topside soundings. A procedure for analyzing topside ionograms, based on a parabolic-in-log N lamination method, is presented which incorporates the actual values of the earth magnetic field at all heights, a change in variable which renders the group path integrand finite at the reflection point (and varying sufficiently slowly elsewhere to be calculated very accurately with a 3-point Gaussian integration technique), and iteration until successive calculations agree to within 0.01 km. A procedure was also developed to insure and accelerate the convergence of the iteration process. The importance of each refinement is discussed and illustrated quantitatively. It is shown that this new N (h) reduction technique can, in theory, yield topside electron density profiles with an altitude accuracy of a few kilometers over a 3000 to 4000 km altitude range. Author

N69-20184# Danish Meteorological Inst., Charlottenlund.
IQSY ASCAPLOTS GREENLAND
K. Lassen and O. Rud Laursen Apr. 1968 95 p refs /ts Geophys. Papers No. R-4 Sponsored partly by Danish State Res. Found.
Avail: CFSTI

Table of ascaplots based on all sky camera exposures at six different stations in Greenland during the IQSY 1964-65 are given. An automatic device for recording time and date on All-Sky films is also described. ESRO

N69-20185# Danish Meteorological Inst., Charlottenlund.
SECTOR STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD AND DAILY VARIATION OF THE GEOMAGNETIC FIELD AT HIGH LATITUDES
L. Svalgaard Aug. 1968 9 p ref /ts Geophys. Papers No. R-6
Avail: CFSTI

Two distinct types of geomagnetic perturbation are apparent in the hourly records of stations in polar regions. Each type persists for several days and it is shown that the changeover is strongly correlated with a change in the overall direction of the interplanetary magnetic field vector. ESRO

N69-20189*# Stanford Univ., Calif. Remote Sensing Lab.
FIELD ANALYSIS OF TERRAIN Final Report, 1 Nov. 1967–31 Oct. 1968
R. J. P. Lyon 20 Dec. 1968 128 p ref
(Contract NAS9-7313; NAS2-3402(F); Grants NGR-05-020-115; NGR-05-020-237)
(NASA-CR-100368) Avail: CFSTI CSCL 08G

The feasibility of using infrared spectrometry outside the laboratory to identify and determine rocks and soils of geological significance is tested. Rock type materials of varying degrees of roughness, particle size, and porosity were observed with the spectrometer and diagnostic data identified. The analog data system was replaced by a fully digital system. A new spectrometer was developed and includes many advances in digital formatting to aid data reduction. The effect of the atmospheric path between the terrain and the experiment was identified, but it has not been possible to use these data in a corrective sense. Author

N69-20203# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
ON MEASURING DISPERSED POPULATIONS
Robert W. Waterhouse Nov. 1968 13 p refs
(AD-681215; CRREL-SR-102) Avail: CFSTI CSCL 8/12

Accuracy and speed of property estimating of randomly dispersed populations can be improved by identifying and accounting for the influence of shape of both the element and the viewing stage. Perimeter intercept count of high density non-overlapping dispersions provides a rapid method of density evaluation, provided the influence of shape on location and orientation of elements and on the random definition of the intercepts is recognized. The efficiency of the circular stage is seen to be due to its randomizing of intercepts. Models demonstrate these influences and comparative accuracy of three systems of estimating. Author (TAB)

N69-20248 Wisconsin Univ., Madison.
A RECONNAISSANCE GEOPHYSICAL SURVEY OF THE NORTH, NORWEGIAN, GREENLAND, KARA, AND BARENTS SEAS AND THE ARTIC OCEAN
Peter Richard Vogt (Ph.D. Thesis) 1968 211 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-9143

Widely scattered geophysical data from the Arctic Ocean, the Norwegian, Greenland, North, Barents, and Kara seas are given and compared with published data. Magnetic profiles in the Norwegian and Greenland seas and the Artic Ocean are interpreted according to the hypothesis that hot mantle material rises at the axis of mid-ocean ridges and then spreads away from the ridge, carrying with it the magnetic polarity of the geomagnetic field at the time of cooling at the axis. Comparison with published results indicates a symmetrical spreading rate of 1 cm/yr for the mid-ocean ridge between Iceland and the Jan Mayen fracture zone, and 1 cm/yr for Mohns Ridge. It is suggested that North America and Eurasia are separating without rotation about a pivot. Magnetic and gravity data are presented for the Alpha Cordillera. Dissert. Abstr.

N69-20255# Adelphi Univ., Garden City, N. Y. Dept. of Mathematics.
A NUMERICAL STUDY OF VERTICALLY PROPAGATING WAVES IN A VISCOUS ISOTHERMAL ATMOSPHERE
M. Yanowitch Feb. 1969 24 p refs Sponsored in part by Natl. Center for Atmospheric Res.
(Grant NSF GA-748)
(AGM-135) Avail: Issuing Activity

This study concerns a one-dimensional time-dependent problem with a periodic excitation at the lower boundary, and solutions are computed until a periodic regime has been established. It is shown that waves may be reflected downward by the action of viscous forces and nonlinear effect (e.g. shock waves). Comparison is made with results of linear theory for the case of small viscosity. Author

N69-20273# United States Lake Survey, Detroit Mich.
GREAT LAKE SOLAR ALTITUDE CHARTS AND TABLES
S. J. Bolsenga Oct. 1968 55 p refs
(AD-680961; RR-5-4) Avail: CFSTI CSCL 3/2

Solar altitudes for 41-49 degrees N latitude, thereby including the Great Lakes region, are presented as a function of solar declination and true solar time in both tabular and graphic forms. Standard astronomical equations were programmed for computer calculations in step widths of 1 deg, 30 min, and 10 minutes for the latitude, declination, and time of day, respectively. Solar altitude variation analysis according to time of the year and geographical location indicates widely variable conditions in the region. Sample daylight duration and sunrise-sunset calculations are given using the tables. Author (TAB)

N69-20279# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
ON THE ORIGIN OF DAY-SIDE AURORAS
Giovanni P. Gregori Consiglio Nazl. delle Ric. May 1967 13 p refs Submitted for publication
(CENFAM-RDP-16) Avail: CFSTI

The incidence direction of the energetic particles that cause auroras is assumed to be given, for each auroral point, by the tangent to the line of the geomagnetic field passing through that point. Statistical results are given on the incidence angle and starting from this result, a few deductions on day-side auroras are made. ESRO

N69-20302# Instituto Geografico y Catastral, Madrid (Spain).
APPLICATION OF THE MAGNETOTELLURIC METHOD OF STUDYING THE DISCONTINUITY OF THE EARTH'S CRUST AND SUPERIOR MANTLE AT TOLEDO [APLICACION DEL METODO MAGNETO-TELURIC AL ESTUDIO DE LAS DISCONTINUIDADES CORTICALES Y DEL MANTO SUPERIOR EN TOLEDO]
Jesus Ray de la Rosa, Luis de Miguel Gonzalez-Miranda, and Secundino Cadauld Camina 1968 51 p refs In SPANISH; ENGLISH summary
Avail: CFSTI

Data from the Geophysical Observatory of Toledo is applied to magnetotelluric sounding in Spain. The analyzed magnetograms and tellurograms, free from influence of external phenomena, pertain to the year 1959. The maximum depth reached was 82 km and the thickness of the overburden was determined at approximately 750 m. Discontinuities were determined at depths of 20 km which was identified as the Conrad surface, at 30 km which corresponded to the Moho, and at 75 km which possibly corresponded to the "Mantle Channel". When the thicknesses of the basaltic and granite layers of the European area were compared with those at Toledo, it appeared that the crust at Toledo corresponded to a precambrian unit reactivated during the Hercynian orogeny. Author

N69-20307# Directorate of Scientific Information Services, Ottawa (Ontario).
ON THE EQUATIONS OF THE INERTIA-GRAVITY FIELD
I. D. Raigorodski Jan. 1969 3 p refs Transl. into ENGLISH from Izv. Vyssh. Uchab. Zaved., Fiz. (Tomsk, USSR), no. 6, 1968 p 96–97
(T-512-R) Avail: CFSTI

Previous investigators in the problems of gravitation have questioned the applicability of Maxwell-type equations in gravity theory. It is concluded in this paper that along with the gravity field proper (in the general relativity theory treatment), there exists an inertia-gravity field, describable by equations of Maxwell type, in which the motion of free particles is along geodesics. Author

N69-20328# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A MODEL OF COSMIC TRIANGULATION BASED ON OBSERVATIONS OF ARTIFICIAL SATELLITES AT VARIOUS TIMES
A. Dinescu Jan. 1968 29 p refs Transl. into ENGLISH from Prace Nablyudfniya Iskusstv. Sputnikov Zemli, PAN (Warsaw), no. 2, 1963 p 26–41
(AD-680997; FTD-HT-23-719-67) Avail: CFSTI CSCL 8/5

The coordinates of observation stations are determined by the space triangulation method using the circle of simultaneity. A model of cosmic triangulation has been calculated for hypothetical satellites on the basis of nonsimultaneous observations. In this method it is not necessary to know the satellite orbit. The author solves the problem in two ways: first using three simultaneous observations of three different satellites and then using two periods of observation and the equation for the tangent plane to the ellipsoid at the point where the station is situated. In both methods, the problem can be simplified in practice by taking two observations of the same satellite, one on the ascending path and another on the descending path on two different dates. Author (TAB)

N69-20348# Laval Univ. (Quebec). Dept. of Civil Engineering.
SEISMIC ZONES OF EQUAL PROBABILITY IN FRANCE

Avinash C. Singhal and Claude Tahiani Jul 1968 30 p refs
(S-6) Avail: CFSTI

A study of seismic regionalization in France is presented. Past earthquake records, obtained from various locations in France, are carefully analyzed and compared with existing earthquake zones in the United States. Using previously developed results on strain-energy release, magnitude, and intensity, the map of zones of equal seismic probability within France has been plotted. A comparative study was made between the existing seismic zone map and the proposed map. It was concluded that the existing zone map of France was too severe for Vosges and Alsace regions and was not severe enough for Brittany, Normandy, Poitou, Massif Central and Aquitaine Basin regions. Since the main purpose of establishing the zone maps was to prevent loss of life and property damage, it was evident that a revision of the existing seismic regionalization map for France was necessary. Author

N69-20386 Pennsylvania State Univ., University Park.
NUCLEATION FACTORS IN THE DEVELOPMENT OF CLOUDS
James Edward Jiusto (Ph.D. Thesis) 1967 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-11992

Nucleation factors and similarities governing particle growth in a variety of cloud types, from fog to warm cumulus, to supercooled clouds were investigated. The relationship between cloud nucleus concentration and subsequent droplet concentration and sizes; the importance of hygroscopic versus nonhygroscopic condensation nuclei in promoting droplet growth in clouds of varying intensity; and the critical concentration of ice nuclei in subcooled clouds to cause effective precipitation were studied. Numerical solutions of the droplet growth equation indicated that at low supersaturations characteristics of fog and stratiform clouds, virtually all cloud droplets condense on hygroscopic nuclei. The growth of giant hygroscopic nuclei was considered in examining two seeding concepts—fog modification and precipitation inducement in clouds. The number of calculated ice nuclei required for complete glaciation of a supercooled cloud as a function on various parameters generally exceeds that occurring naturally in the free atmosphere during early stages of cloud glaciation. By adding ice nuclei to the cloud, both the dominant crystal growth mechanism and snowfall distribution pattern might be altered. Dissert. Abstr.

N69-20396# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
TRANSFORMATIONS OF THE ELASTIC CONSTANTS FOR ANISOTROPIC MEDIA BY SUCCESSIVE SIMPLE ROTATIONS
Thomas R. Bur Mar. 1969 19 p refs
(BM-RI-7243) Avail: Issuing Activity

This method of performing general transformations by use of Eulerian angles greatly reduces the time required for the determination of values for the elastic compliance constants (s_{ij}), elastic stiffness constants (c_{ij}), Young's modulus, shear modulus, or Poisson's ratio for any orientation of the cartesian coordinate system in an anisotropic material. Author

N69-20405# Aerospace Corp., El Segundo, Calif. Lab. Operations.
OXYGEN ABSORPTION IN THE EARTH'S ATMOSPHERE Technical Report, May 1965–Mar. 1968
Earl E. Reber, Richard L. Mitchell, and Clarence J. Carter Nov. 1968 102 p refs
(Contract F04701-68-C-0200)
(AD-680771; TR-0200(4230-46)-3; SAMSO-TR-68-488) Avail: CFSTI CSCL 20/14

An extensive measurement program designed to measure the attenuation of electromagnetic energy in the oxygen absorption spectrum (at 5-mm wavelength) by the atmosphere is described. Measurements were made utilizing the sun as a source at six discrete altitudes ranging from sea level to 13.7 km and over a frequency range of 53.4 to 56.4 GHz. The more than 1500 independent attenuation measurements were used to calculate new values for the Van Vleck line-broadening coefficients. Zenith attenuations were computed utilizing these new coefficients over the frequency range 48 to 72 GHz and for several altitudes from 0 to 25 km. In addition, both horizontal attenuation rates and tangential attenuations through the atmosphere have been computed for several altitudes. Author (TAB)

N69-20422# France. Direction de la Meteorologie Nationale, Paris.
EVAPO-TRANSPIRATION–AGROMETEOROLOGICAL ASPECT. PRACTICAL EVALUATION OF EVAPO-TRANSPIRATION POTENTIAL [L'EVAPOTRANSPIRATION–ASPECT AGROMETEOROLOGIQUE. EVALUATION PRATIQUE DE L'EVAPOTRANSPIRATION POTENTIELLE]
P. Brochet and N. Gerbier Oct. 1968 69 p refs In FRENCH
Its Monographies No. 65
Avail: CFSTI

A review is given of the essential ideas concerning evapotranspiration, evapotranspiration potential, and in a general fashion, water transfers between the sun, the plant, and its environment. It is shown, in particular, that these ideas can be practically applied in the agricultural field. Evaluation of evapotranspiration potential is treated. Four formulas are developed: Thornthwaite, Turc, Penman, and Bouchet. For the latter, a particular attempt is made to define the meaning and the local and temporal fluctuations of the coefficient α, and to connect it to a relatively simple climatic index. Transl. by P.A.B.

N69-20432# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
HARMONIC CONSTANTS OF TIDE, FORECASTING OF TIDE AND TIDAL CURRENTS BY MEANS OF COMPUTERS [CONSTANTES HARMONIQUES DE MAREE, PREVISION DE LA MAREE ET DES COURANTS DE MAREE A L'AIDE DE CALCULATEURS ELECTRONIQUES]
M. Giorgi and C. Stocchino Consiglio Nazl. delle Ric. Feb. 1968 21 p refs In FRENCH Submitted for publication
(CENFAM-RDP-11) Avail: CFSTI

Numerical computers are used for processing tidal information and data. Harmonic constants of tides are given and the block diagram is shown of the data processing system. Forecasting of tides and tidal currents is done by means of IBM-7090 computer programs. ESRO

N69-20433# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
ON THE CORRELATION BETWEEN GEOMAGNETIC ACTIVITY INDEX K_p AND THE AURORAL HEIGHT: PRELIMINARY RESULTS [SULLA CORRELAZIONE TRA L'INDICE DI ATTIVITA GEOMAGNETICA K_p E LA QUOTA DELLE AURORE: RISULTATI PRELIMINARI]
Franco M. Vivona Jun. 1968 13 p refs In ITALIAN Presented at the 53rd Cong. of the Italian Soc. of Phys., Bologna, 23–28 Oct. 1967 Submitted for publication
(CENFAM-RDP-23) Avail: CFSTI

A statistical study concerning the correlation between the geomagnetic activity index K_p and the height of the lower border of 1000 auroral displays, observed in Norway and in Alaska before

the IGY, is described. Results are given and discussed; it turns out that the K_p-index is not completely adequate for this kind of study.
Author (ESRO)

N69-20438# Maury Center for Ocean Science, Washington, D. C.
US NAVY PARTICIPATION IN THE BARBADOS OCEANOGRAPHIC AND METEOROLOGICAL EXPERIMENT
Jan. 1969 31 p refs
(AD-681085; MC-1) Avail: Issuing Activity CSCL 8/10

The Barbados Oceanographic and Meteorological Experiment (BOMEX) is a large-scale air-sea-interaction field experiment scheduled to be conducted in the vicinity of the island of Barbados in late spring and early summer 1969. The air-sea-interaction objectives of the experiment are (1): (a) Study of the vertical flux of momentum, sensible heat, latent heat, radioactivity and other properties at the interface and the horizontal transport of these properties through the lateral boundaries of the observational array. (b) Study of the vertical and horizontal divergence of these fluxes within the interior of each fluid. (c) Study of the feasibility of parameterizing the area wide integral of at least the surface fluxes from conventional observation at the fixed corners of the array. Related studies in physical oceanography and micro- and meso-scale meteorology also are to be undertaken. BOMEX will provide an excellent opportunity to conduct related experiments within a well-controlled observational network.
Author (TAB)

N69-20482# Air Force Cambridge Research Labs., Bedford, Mass.
CONVERSION, MAINTENANCE, AND UPDATING OF MAGNETOGRAPH DATA FILES
Helen L. Roehrig Jul. 1968 47 p *Its* Spec. Rept. No. 78
(AD-681102; AFCRL-68-0387) Avail: CFSTI CSCL 8/14

This paper describes the analysis and design required to develop a system of computer programs to implement a changeover from punched cards to magnetic tape for the permanent storage of varying-area film magnetograph data. Instead of three sets of biweekly magnetographs stored in a punch card deck, all biweekly magnetographs for one station are stored on a reel of magnetic tape. The system is designed to process one reel of tape containing not more than ten decks of raw source data. The printed output from each program in the system collectively represents a step-by-step documentation of the conversion of data storage from punched cards to magnetic tape. An index of magnetograms stored on magnetic tape is printed out for each station letter when conversion of the data storage of one reel of raw source data is completed.
Author (TAB)

N69-20491# Air Force Cambridge Research Labs., Bedford, Mass.
TABLES OF SELECTED PLANE EARTH REFLECTION COEFFICIENTS, 5 TO 100 KHz
John L. Heckscher Oct. 1968 112 p *Its* Environ. Res. Papers No. 293
(AD-681104; AFCRL-68-0527) Avail: CFSTI CSCL 4/1

Tables for the amplitudes and phases of plane waves reflected from a plane, homogeneous earth were calculated using the Fresnel equations. The total fields at the reflecting surface resulting from the combination of the incident and reflected waves were computed for one component of the electric field, and for two components of the magnetic field. The angle of incidence was varied from 0 to 90 degrees in two-degree steps, and the frequency was varied from 5 kHz to 100 kHz in 5-kHz intervals. Computations were made using five combinations of earth conductivity and dielectric constant more or less typical of sea water, fresh water, ice, poor soil, and good soil, assuming a relative magnetic permeability of unity.
Author (TAB)

N69-20587# Oceanics, Inc., Plainview, N. Y.
ON THE SELECTION OF AN OPTIMUM SPECTRAL WINDOW FOR ANALYSIS OF CERTAIN CLASSES OF TIME SERIES DATA Final Report
Wilbur Marks Dec. 1968 39 p refs
(Contract Nonr-3961(00))
(AD-681098; REPT-66-28) Avail: CFSTI CSCL 9/4

The study is aimed at providing insight into selection of optimum spectral windows appropriate to different populations representing oceanographic and geophysical events. From solution of 2nd order and 4th order differential equations, two single-peak and two double-peak spectra are derived. Locations of peak frequency and bandwidth are varied to provide four different representative populations. For each, time histories are generated, and spectral estimates are made for different lengths of record and for different resolution, with 6 spectral (lag) windows applied. It is found that for total variance, any of the spectral windows would give a good estimate. Where shape of the spectrum is important, the DTMB and Prazen (II) windows tend to provide the best approximation to the true spectrum. The integrated mean square error is used as the figure of merit in evaluating the efficacy of the different windows.
Author (TAB)

N69-20574# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SURGES OF CONSIDERABLE STRATOSPHERIC TEMPERATURE FLUCTUATIONS OVER ARMENIA
G. D. Zubyan Jun. 1968 15 p refs Transl. into ENGLISH from Doki. Akad. Nauk Arm. SSR (Erevan), v. 42, no. 3, 1966 p 159–165
(AD-681270; FTD-MT-24-111-68) Avail: CFSTI CSCL 4/1

The paper gives some results of investigation of the stratosphere over Armenia on the basis of daily aerological observations at Yerevan in 1961. Periodic temperature changes in Armenia occur not only in the troposphere and lower stratosphere, but also in the higher layers of the latter, possibly to its upper boundary. These variations are observed for the most part in the warm season of the year and in the middle stratosphere frequently attain 10-15 degrees in 1-2 days. The most important causative factor apparently is vertical air movements induced by the stratospheric subtropical frontal zone. The article gives an extremely well-expressed case of this stratospheric temperature change in the second half of August, 1961. At the same time, the temperature fluctuations in the troposphere were up to 10-14 degrees but the temperature changes in the stratosphere and troposphere were opposite in sign.
Author (TAB)

N69-20807# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
FIRST GENERAL DOCUMENTATION ON THE METEOROLOGICAL CONDITIONS RELATED TO THE LARGE FLOOD OF NOVEMBER 1966. PART 1: DESCRIPTION [PRIMA DOCUMENTAZIONE GENERALE DELLA SITUAZIONE METEOROLOGICA RELATIVA ALLA GRANDE ALLUVIONE DEL NOVEMBRE 1966. PARTE 1: RELAZIONE DESCRITTIVA]
Consiglio Nazl. delle Ric. Mar. 1967 49 p refs In ITALIAN
Submitted for publication
(CENFAM-RDP-12) Avail: CFSTI

Some particular meteorological conditions have caused a very large flood in Italy during November 1966. After a brief description of general principles of meteorology the author examines all the meteorological conditions taken by a meteorological satellite.
ESRO

N69-20608# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).
FIRST GENERAL DOCUMENTATION ON THE METEOROLOGICAL CONDITIONS RELATED TO THE LARGE FLOOD OF NOVEMBER 1966. PART 2: TABLES [PRIMA DOCUMENTAZIONE GENERALE DELLA SITUAZIONE METEOROLOGICA RELATIVA ALLA GRANDE ALLUVIONE DEL NOVEMBRE 1966. PARTE 2: TAVOLE]
Consiglio Nazl. delle Ric. Mar. 1968 106 p in ITALIAN Submitted for publication
(CENFAM-RDP-12-Pt-2) Avail: CFSTI

Weather charts and cloud photographs taken by a meteorological satellite are compiled. They show the meteorological conditions before and during the flood in Italy in 1966. Supplement to CENFAM-RDP-12. ESRO

N69-20655# Directorate of Scientific Information Services, Ottawa (Ontario).
PACIFIC OCEAN WATERS IN THE ARTIC BASIN
Ye. M. Gushchenkov Sep. 1968 5 p refs Transl. into ENGLISH from Priroda (Moscow), no. 5, 1968 p 108–109
(T-505-R) Avail: CFSTI

Research was done in the Arctic Basin for the purpose of moderating climatic conditions in the northern latitudes. It was suggested that the Bering Strait be bridged with a dam shutting out the Pacific waters. Calculations of the thermal effect of constructing the dam showed: (1) The stepped-up influx of Atlantic waters into the Arctic Basin would not make good the thermal deficit that would be caused by the loss of the heat brought into the Basin by the Pacific Ocean waters. (2) The Pacific waters penetrate into the Arctic Basin and are drawn into circulation causing a warming trend in the Arctic waters. (3) Cutting off completely the access of Pacific water would destroy the warming effect in the Basin. B.G.D.

N69-20657# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
AN EXPERIMENTAL STUDY ON ARTIFICIAL CONDENSATION NUCLEI
Je Jia-Dong Bedford, Mass. AFCRL Dec. 1968 20 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 32, no. 3, 1962 p 232–239
(Contract F19628-68-C-0251)
(AD-681106; EMM-68-199; AFCRL-68-0629; Trans-36) Avail: CFSTI CSCL 4/2

This paper deals with the experimental determination of the rate of condensation around different types of soluble microscopic nuclei (NaCl, MgCl2, NH4Cl, CaCl2, P2O5, NH4NO3, (NH4)2SO4, etc.) and suspensoids such as camphor, silicon minerals, kaolin, lamp black, and calcium lime (CaO). The findings reveal that the above mentioned soluble nuclei and camphor powder are active artificial hygroscopic condensation nuclei and that lamp black, silicon aerosols, and kaolin are inactive nuclei around which no significant growth by condensation takes place in an unsaturated moist atmosphere. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N69-19618*# TRW Systems Group, Redondo Beach, Calif.
STUDY OF THE REMOTE MEASUREMENT OF OCEAN COLOR Final Report, 28 Aug. 1967–28 Jan. 1968
Richard C. Ramsey 28 Jan. 1968 98 p refs
(Contract NASw-1658)
(NASA-CR-100294) Avail: CFSTI CSCL 08J

The results of a study to evaluate the factors which affect remote measurements of ocean color and to define a set of requirements for a system to make these measurements from a spacecraft are presented. The effects of atmosphere, sun, ocean surface, and ocean contents on these measurements are evaluated. Calculations of upward flux through the atmosphere from ocean waters containing various amounts of chlorophyll are used to define the system requirements. A preliminary design of a sensor is provided with the capability of distinguishing between zero and 0.2 mg/m^3 of chlorophyll in ocean waters. This design requires the measurement of upward flux in 15 spectral bands with a ground resolution of 2500 feet and yields total ocean coverage in 14 days from a 287 nautical mile sun-synchronous orbit. Author

N69-19630# Battelle-Northwest, Richland, Wash.
ACOUSTIC HOLOGRAPHY FOR NUCLEAR INSTRUMENTATION
B. P. Hildebrand 6 Nov. 1968 28 p refs Presented at the Intern. Conf. on the Constructive Uses of Atomic Energy, Washington, D. C.
(Contract AT(45-1)-1830)
(BNWL-SA-2017; CONF-681101-5) Avail: CFSTI

The development of ultrasonic holography for reactor vessel inspection and surveillance is described. The historical development of holography is discussed. NSA

N69-19639# Brookhaven National Lab., Upton, N. Y.
DIGITIZED SPARK CHAMBER AND ON-LINE COMPUTER SYSTEMS FOR DOUBLE VERTEX EVENTS
S. J. Lindenbaum Sep. 1968 22 p refs Presented at the Intern. Symp. on Nucl. Electron., Versailles, France
(BNL-12900; CONF-680906-7) Avail: CFSTI

A new double V (vertex) magnetic spectrometer system which has been under development at BNL for the past several years is described. The system is suitable for the automatic detection and measurement of the momenta of the charged decay particles from double vertex events and is scheduled to be tested at the AGS this winter and spring. The system contains two multi-particle detecting magnetic spectrometer arms, utilizing spark chamber hodoscopes (i.e., wire chambers) with automatic digitization of spark location, via magnetostrictive readout digitized by scalar readings. The data are handled by a local data handler which stores the raw data in a local computer memory and between AGS pulses (every 2.5 sec) sends a preselected sample to the PDP-6 computer system of the Brookhaven On-Line Data Facility. This on-line data facility equipment is being used by many Brookhaven user groups in a variety of digitized spark chamber and counter experiments and is treated separately. Author (NSA)

N69-19666# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
AUTOMATIC COUNTING AND RECORDING UNIT USED FOR DATING BY THE CARBON 14 [METHOD ENSEMBLE DE COMPTAGE ET D'IMPRESSION AUTOMATIQUE UTILISE POUR LA DATATION PAR LA METHODE DU CARBONE 14]
Pierre Albertinoli, ... (Centre Natl. d'Etudes Spatiales, Bretigny-sur-Orge), Jean Galliot, and Jean Thommeret Jan. 1969 63 p refs In FRENCH; ENGLISH summary
(CEA-R-3702) Avail: CFSTI

A description is given of the unit used by the Centre Scientifique de Monaco for low-level beta counting and fitted for radioactive dating by the Carbon 14 method. Built entirely by the laboratory in 1964, on the basis of current electronic techniques it has worked without failure since that time. The proportinal counter, its high-voltage negative supply, and the counting chains with visual and printing records are detailed by means of 38 figures which reproduce the counter and electronic circuits. These are contained in two standard 5 U I chassis. The low-voltage power supply of the whole unit is carried out by plus 12 volt and minus 12 volt storage batteries, buffered on a charger connected on the 110 V alternative line. The proportional counter is filled with CO_2 under one atmosphere pressure and permits the dating of carbonaceous samples to a maximum of 30 000±1 000 years (background 3.96 c.p.m.) within a moderate time (72 hours).
Author (ESRO)

N69-19672# Centre National de la Recherche Scientifique, Meudon (France). Lab. d'Aérothermique.
FLUORESCENCE PROBE ACTIVATED BY AN ELECTRON BEAM FOR THE STUDY OF RAREFIED GAS FLOW [SONDE A FLUORESCENCE INDUITE PAR UN FAISCEAU ELECTRONIQUE POUR L'ETUDE DES ECOULEMENTS DE GAZ RAREFIES]
Michel Cloupeau and Raymond Galinaro Jun. 1968 47 p refs In FRENCH
(REPT-68-3) Avail: CFSTI

The principles on which the probe is based are given and the measurements that can be obtained are discussed. Difficulties encountered in using the probe are analyzed. Special attention must be paid to the constancy of the intensity of the electron beam during the time of measurement and to the fact that the light emitted by an element of volume scanned by the electron beam depends on the density gradient at the level of this element.
Author (ESRO)

N69-19683# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
STUDY OF TRANSFER-REACTIONS (α,t) (α,^{3}He) IN THE F-P SHELL : MECHANISM AND SPECTROSCOPIC USE [ETUDE DES REACTIONS DE TRANSFER (α,t),(α,^{3}He) DANS LA COUCHE F-P: MECANISME ET UTILISATION SPECTROSCOPIQUE]
Pierre Roussel (Ph.D. Thesis--Paris Univ., 22 May 1968) Dec. 1968 52 prefs In FRENCH; ENGLISH summary
(CEA-R-3595) Avail: CFSTI

An experimental study of (α,t), (α,^{3}He) reactions at 44 MeV using a solid-state identifier, on the target-nuclei ^{54}Fe and ^{58,60,62,64}Ni are described. A critical study of an optical model and a distorted wave analysis were performed. The complementarity of different transfer-reactions, the ambiguity of spectroscopic factors and the importance of the problem of the reaction mechanism are discussed.
Author (ESRO)

N69-19745# Royal Aircraft Establishment, Farnborough (England).
THE EFFECTS OF RADIATION AND METHOD OF ATTACHMENT ON THE ACCURACY OF THERMOCOUPLES USED FOR SURFACE TEMPERATURE MEASUREMENT [INFLUENCE, LORS DE MESURES DE TEMPERATURES DE SURFACE A L'AIDE DE THERMOCOUPLES, DU RAYONNEMENT RECU PAR CEUX-CI, ET DE LEUR MODE DE FIXATION]
Henri Bouissou Oct. 1968 20 p refs Transl. into ENGLISH from Ann. Phys. (Paris), no. 7, 1962 p 535-544
(RAE-LIB-TRANS-1326) Avail: CFSTI

It was proposed to study the extent to which the radiation received by thermocouple wires affects the readings given by the latter, and more particularly, to ascertain whether this effect can be neglected in techniques used by certain authors who reported evidence of anomalies; such anomalies were not found with other measuring techniques. The conclusion is reached that the effects of this radiation are not negligible. It was further established that the method of fixing the thermocouple is of considerable importance. An attempt is made to interpret the results obtained from a physical aspect.
Author

N69-19755*# ITT Aerospace/Optical Div., Fort Wayne, Ind.
IMAGE DISSECTOR CAMERA SUBSYSTEM, ASSOCIATED GROUND SUPPORT EQUIPMENT, AND INTEGRATION SUPPORT FOR APPLICATIONS TECHNOLOGY SATELLITE Final Report, May 17, 1966--Nov. 17, 1968
3 Dec. 1968 24 p
(Contract NAS5-10200)
(NASA-CR-100328; ITTIL-68-043) Avail: CFSTI CSCL 14E

A chronological review of activities covering the fabrication and testing of a flight model image dissector camera for the Applications Technology Satellite is presented. The design, fabrication, test, and installation of two sets of ground station equipment and the field service support of these equipments through integration, pre-launch, launch, and post-launch activities are discussed.
Author

N69-19763# Aeronautical Research Council (Gt. Brit.)
A BATTERY-OPERATED FOUR-CHANNEL TAPE RECORDER FOR USE IN ACOUSTIC MEASUREMENTS IN FLIGHT
F. L. Hunt and B. Fairhead 1968 19 p Supersedes RAE-TR-66319; ARC-28940
(ARC-CP-1010; RAE-TR-66319; ARC-28940) Copyright. Avail: CFSTI; HMSO, London: 4s

This report describes a self-contained battery-operated four-channel tape recorder which has been designed particularly for the direct recording of audio frequency signals in a research aircraft where installation space was strictly limited and where no operating power was available from the aircraft electrical system.
Author (ESRO)

N69-19799# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
USE OF A URANIUM ORE FOR THE OVERALL CALIBRATION OF GAMMA SPECTROMETERS [UTILISATION D'UN MINERAI D'URANIUM POUR L'ETALONNAGE GLOBAL DE SPECTROMETRES GAMMA]
Marcelo Robert Dec. 1968 62 p In FRENCH; ENGLISH summary
(CEA-R-3692) Avail: CFSTI

In analytical laboratories using γ spectrometry, the need for a range of standards has led to the study of sources made up of a mineral ore with a view to its exclusive use for the overall calibration of measuring equipment. The qualities of such a source, stable under certain conditions and giving a spectrum made up of a large number of well distributed peaks, shows practical advantages but due to the varieties of ore, it can only provide a secondary calibration. The ore used has a relatively low specific activity, thus avoiding large self-absorption corrections at low energies.
Author (ESRO)

N69-19854# Library of Congress, Washington, D. C. Aerospace Technology Div.
MAGNETOMETER USED ON BOARD THE LUNA-10 AND VENERA-4 PROBES
In its Foreign Sci. Bull., Vol. 5, No. 1 Jan. 1969 p 84–88 refs (See N69-19851 09-34)
Avail: Issuing Activity

A magnetometer for measurements of the geomagnetic and interplanetary magnetic fields is described. The magnetometer, designated the SG-59M, is of the flux gate type. It is composed of two basic units, a transducer and a transistorized electronic unit. The transducer unit contains three flux gate sensors whose magnetic axes are mutually perpendicular. Functionally, therefore, the magnetometer consists of three independent channels corresponding to the number and directions of the magnetic field components which it is capable of measuring. Each sensor consists of two 79NM-A permalloy cores. The sensor excitation windings, having 300 turns of PEV wire 0.2 mm in diameter, are wound along the entire length of the cores. Author

N69-19856# Federal Aviation Administration, Washington, D. C. Systems Research and Development Service.
UTILIZATION OF TIME/FREQUENCY IN COLLISION AVOIDANCE SYSTEMS (CAS)
[1968] 166 p refs Meeting held at Washington, 27–28 Aug. 1968
Avail: Issuing Activity

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10. TIME DISSEMINATION BY SATELLITE G. C. Weiffenback (APL/JHU) p 85–88 (See N69-19866 09-07)

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12. REMARKS ON NASA SATELLITE TRACKING AND DATA ACQUISITION NETWORK (STADAN) M. E. Shawe (NASA. Goddard Space Flight Center) p 95 (See N69-19868 09-07)

13. REMARKS ON GEOS TIME SYNCHRONIZATION S. C. Laios (NASA. Goddard Space Flight Center) p 96–99 (See N69-19869 09-14)

14. REMARKS ON ATS TIME SYNCHRONIZATION S. C. Laios (NASA. Goddard Space Flight Center) p 101–104 (See N69-19870 09-14)

15. REMARKS ON ASTRODATA TIMING SYSTEM S. C. Laios (NASA. Goddard Space Flight Center) p 105 (See N69-19871 09-14)

16. SYNCHRONIZATION EXPERIMENT FOR A TIME DIVISION MULTIPLE ACCESS SATELLITE COMMUNICATION SYSTEM W. K. Allen (NASA. Goddard Space Flight Center) and J. G. Dunn (ITT Federal Labs) p 107–110 refs (See N69-19872 09-07)

17. WORLD-WIDE TIME REVIEW G. M. R. Winkler p 111–122 (See N69-19873 09-14)

18. REMARKS ON THE APPLICATION OF RF SPECTROSCOPY OF STORED IONS TO FREQUENCY STANDARDS F. G. Major (NASA. Goddard Space Flight Center) p 125–126 refs (See N69-19874 09-14)

N69-19859*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON WORLD WIDE TIME SYNCHRONIZATION BY VLF
Andrew R. Chi *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 23–30 (See N69-19856 09-14)
Avail: Issuing Activity CSCL 14B

The technique of using dual VLF transmissions for time synchronization of remote station clocks is developed. Timing information is obtained from the relative phase delay of two received signals for a given propagation path. If the propagation path length is assumed to be constant, the cycle of a received carrier can be determined directly from the relative phase delay. A specially designed receiver is used for the determination of the relative phase of the two received signals. However, two separate VLF phase tracking receivers can be used. In either approach, the receiver delay is removed by the use of a calibrator which generates a spectrum of the frequencies at 100 Hertz separation in the VLF band. Phase tracking of a VLF signal is measured by the phase difference between the calibrating signal and the received signal. It is to be noted that the received signal is locked at the positive going zero crossing of a cycle which is a characteristic or design of a VLF phase tracking receiver. Author

N69-19860# Federal Aviation Administration, Washington, D. C.
PRECISE TIME AND TIME INTERVAL (PTTI) ACTIVITIES AND PLANS (USAF)
Ernest L. Kirkpatrick *In its* Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 31–36 (See N69-19856 09-14)
Avail: Issuing Activity

Precise time carrying to some ten systems or about forty sites is graphically illustrated through the composition of a redundant clock system for precise time reference stations. Precise time and time interval equipment for a proposed measurement equipment laboratory includes two crystal clocks connected to a comparator, a Loran and an omega receiver, a time interval counter, and error multiplier, as well as associated equipment for obtaining and maintaining time. G.G.

N69-19861# Federal Aviation Administration, Washington, D. C.
OPEN DISCUSSION OF SYNCHRONIZATION BY TRANSPORTABLE CLOCKS
In its Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 37 (See N69-19856 09-14)
Avail: Issuing Activity

Some experimentation in the transfer of time using crystal oscillators has shown that closure errors of 0.1 usec, with a 2.5 MHz crystal oscillator and .3 usec, with a 5.0 MHz crystal oscillator are achievable. Stabilities of commercially available crystal oscillators such as Sulser are: 1 part in 10^{-10} over 24 hours, and 1 part in 10^{-11} over a 2-hour period. Measurement of a laboratory crystal oscillator against a Cesium Beam oscillator, shows a stability of: 5 parts in 10^{-12} for 16 seconds, and 5 parts in 10^{-12} for 160 seconds. Author

N69-19862# Federal Aviation Administration, Washington, D. C.
USE OF LORAN-C FOR TIMING
Paul E. Pakos *In its* Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 39–50 (See N69-19856 09-14)
Avail: Issuing Activity

Loran C skywaves from the same chain of stations are synchronized to the master within ± 0.2 microseconds (3 sigma) and thus can be used by any number of clocks set to each other as long as they utilize stations from the same chain. The user has only to establish the precise propagation time from the station to his position, or he needs calibration by a single visit from a portable clock. G.G.

N69-19864# Federal Aviation Administration, Washington, D. C.
NAVY TIME FREQUENCY PROGRAMS
Martin Pozesky *In its* Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 57–69 (See N69-19856 09-14)
Avail: Issuing Activity

Electronic system requirements for time frequency networks will incorporate a cesium standard with selected crystal clocks for tactical and continental synchronization. Distribution will be by disciplined crystal oscillators at the termination end of coax cables and synchronization will address flight time to existing and planned data links. World wide synchronization will use cesium and rubidium clocks together with the Omega system or satellites. G.G.

N69-19867*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON FREQUENCY COMBINER AND MICROELECTRONIC CLOCK
M. E. Shawe *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 89–94 (See N69-19856 09-14)
Avail: Issuing Activity CSCL 14B

Advantages and characteristics of a microelectronic timing system using atomic standards, a frequency combiner, and a microelectronic clock are discussed. The frequency standard incorporates atomic frequency control of quartz standards with identical long term frequency outputs from several controlled standards and the microelectronic clock incorporates three independent clocks with majority voted output and error indicators. G.G.

N69-19869*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON GEOS TIME SYNCHRONIZATION
Straton C. Laios *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 96–99 (See N69-19856 09-14)
Avail: Issuing Activity CSCL 22D

The GEOS spacecraft uses a crystal clock time signal epoch for time synchronization with a ground station generated pulse each time it passes over a tracking station of the data acquisition network. Thus, a capability of time synchronization to 50 microseconds of universal time coordination is obtained by the network. G.G.

N69-19870*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON ATS TIME SYNCHRONIZATION
Straton C. Laios *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 101–104 (See N69-19856 09-14)
Avail: Issuing Activity CSCL 22A

The application technology Satellite (ATS) will be used to time synchronize network ground stations by simultaneously transmitting timing signals between a master and a slave station. Each station starts a time interval counter by the signal it transmits and stops the counter by the signal it receives. The time error between the stations is the time interval measured at the slave divided by two. The stations can be synchronized to within 15 microseconds by this method. G.G.

N69-19871*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON ASTRODATA TIMING SYSTEM
Stranton C. Laios *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 105 (See N69-19856 09-14)
Avail: Issuing Activity CSCL 14B

The Astrodata Timing System is a highly reliable, redundant, flexible solid state device. It employs triple redundant digital clocks and code generators. Each clock and generator contains its own power system. The power system consists of redundant power supplies and uses batteries as backup power in case of line failure. The digital clocks are driven from one of two Sultzer 2.5 oscillators. In case of failure of one oscillator, the system automatically switches to the other. The system employs majority logic to drive its distribution system. The majority logic output is the two of the three clock inputs that are the same. Hence, in case of failure of one clock, the user will not see a loss of signal. The timing system also contains malfunction detectors to find errors in the clocks. The outputs of the system are pulse rates from a 100 K pps to 1 pps in decade steps, sine waves from 5 MC to 60 cps, parallel time of year and the four NASA time codes (NASA 1/sec., 1/min., 1/hr., and the serial decimal time code). Author

N69-19873# Federal Aviation Administration, Washington, D. C.
WORLD-WIDE TIME REVIEW
G. M. R. Winkler *In its* Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 111–122 (See N69-19856 09-14)
Avail: Issuing Activity

Basic principles and concepts of long distance time synchronization are evaluated and a cesium beam clock reference system is developed as the only feasible economic approach because it needs sub-microsecond synchronization only once a week. This can be accomplished by either portable clocks or flyover services with Loran C as backup, by satellite synchronization, or a combined Omega/very low frequency/Loran C skywave method. Precision in the order of tens (10s) of nanoseconds will be obtained with two way satellite microwave links. G.G.

N69-19874*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON THE APPLICATION OF RF SPECTROSCOPY OF STORED IONS TO FREQUENCY STANDARDS
F. G. Major *In* FAA Util. of Time/Freq. in Collision Avoidance Systems (CAS) [1968] p 125–126 refs (See N69-19856 09-14)
Avail: Issuing Activity CSCL 14B

Projected is the development of a portable atomic standard device that contains trapped ions by tailored high frequency electromagnetic fields in a high vacuum. This method achieves exceedingly small line widths; for example, mass 199 isotope ions of mercury have a hyperfine frequency fractional line width of about 10^{-12} for a containment time of about 10 seconds. Optical pumping or spin-dependent atomic collision processes can be used to correct ion state inversions. G.G.

N69-19900# Sandia Corp., Albuquerque, N. Mex.
UNDERWATER SEARCH OPERATION: NIMBUS B/SNAP 19 GENERATORS
Nov. 1968 35 p
(SC-DR-68-809) Avail: CFSTI

The Sandia underwater search operation which located and photographed two SNAP 19 generators in approximately 300 feet of water off the coast of southern California is described. The generators, part of Nimbus B weather satellite, were lost when the Thorad/Agena vehicle was destroyed. A high-resolution (200 kHz) side-looking sonar and a free submersible with optics were evaluated during the search. Author (NSA)

N69-19948*# General Precision, Inc., Wayne, N. J. Kearfott Systems Div.
FLUIDIC ACCELEROMETER, PHASE 1 Final Report
John Evans 5 Sep. 1968 28 p
(Contract NAS8-20780)
(NASA-CR-98357) Avail: CFSTI CSCL 14B

The fluidic accelerometer consists of a cylindrical mass, supported radially on a pressurized gas bearing and captured axially between two pressurized pads. Axial acceleration causes the proof mass to move towards one pad and away from the opposite pad. This causes the exhaust area of one pad to decrease while the other increases. This, in turn, causes a differential pressure to exist across the pads which acts on the proof mass, accelerating it. This differential pressure is proportional to the input acceleration and is the output of the accelerometer. This report includes a derivation of the working equations of the instrument, the test results on the two units built, a discussion of the results, the specifications to which the instrument was built, and an outline drawing. Author

N69-19986 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
ELECTRONIC INSTRUMENTATION
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 23-35 refs
(See N69-19981 09-34)
(Grant NIH 1-505-FR07047-01)
Avail: CFSTI

During the past quarter, theoretical studies of the effects of power-supply variations on mass-spectrometer resolution have been completed. A new project has been initiated to investigate scanning techniques for detection systems employing a definite number of detectors. Also, ultrahigh stability power-supply circuits are being tested for possible application in the mass-spectrometer system. Author

N69-20041 Florida Univ., Gainesville.
WAVEFORM ANALYSIS OF GEOGRAPHIC PATTERNS RECORDED ON VISIBLE AND INFRARED IMAGERY
Richard Everett Witmer (Ph.D. Thesis) 1967 236 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.05 Order No. 68-13042

This study is part of a long-range program of investigation into the methodology and application of research techniques which objectively measure geographic patterns and distributions using electronic instrumentation. The primary objectives of this study were: (1) the application and refinement of an electronic technique for scanning visible and infrared imagery, and (2) the development of a methodology which would allow discrimination between various terrain types recorded on such imagery. Two sets of multispectral imagery were chosen for waveform analysis. Each set represented a sampling of different portions of the visible and infrared wavelengths, and also represented a different group of sensors. Dissert. Abstr.

N69-20045 Pennsylvania State Univ., University Park.
HIGH SPEED CALORIMETRY IN THE IRON-CARBON SYSTEM BETWEEN 600°C AND 1600°C
Ko Yamaguchi (Ph.D. Thesis) 1967 108 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-12016

A high-speed, high temperature calorimeter with a new concept has been designed and constructed. The heat sink of the calorimeter is made from a continuous copper wire formed into a coil which simultaneously serves as a resistance thermometer. The heat lost by the sample is captured by the coil, which completely surrounds the sample and the resistance change of the wire is measured during the experiment. This almost completely eliminates the time lag which is usually encountered when measuring the temperature of the heat sink in conventional calorimeters and also eliminates the error due to temperature non-uniformity within the heat sink. The calorimeter constructed is particularly well suited for investigations of the heats of solidification and transformation of metals and alloys at high temperatures with the least expenditure of time but with sufficient accuracy. Dissert. Abstr.

N69-20061# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT IMPROVE: INVESTIGATION OF VARIOUS TECHNIQUES FOR ENHANCING IMAGES
Thomas M. Holladay Dec. 1968 54 p refs
(CAL-VE-2548-D-1) Avail: Issuing Activity

Stationary and nonstationary processes of image enhancement are discussed. It is seen that most of the techniques belong to the stationary processes because of the more rigorous mathematical techniques available and easier implementation. A technique was discovered for introducing a quadratic phase filter in a coherent optical system without using a filter. This quadratic phase filter was introduced by an appropriate amount of defocus and was used as an approximation to a filter for defocus correction to enhance a tribar resolution chart. Results of the differentiation-shifting and adding process for removing image motion reveal that the effectiveness of repeated applications optically or digitally is critically dependent on the noise level. A spatial filter was proposed which could accomplish the repeated application of the DSA process in one step. Optical processing as a means of enhancing cineangiogram images was shown to be a feasible technique of outlining the image of a heart. A one dimensional nonstationary filter was developed which does a creditable job of distinguishing between different signal levels even at low signal to noise ratios. Author

N69-20097 Ohio State Univ., Columbus.
ERROR PROPAGATION IN STRIP TRIANGULATION AND THE STANDARD ERRORS OF THE ADJUSTED COORDINATES
Afifi Hassan Soliman (Ph.D. Thesis) 1968 212 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-12875

The purpose of this investigation was to develop new formulas for adjustment of strip triangulation and the standard error of the adjusted coordinates. These formulas are based on a complete theoretical study of the error propagation in strip triangulation. This study developed the basic factors limiting the accuracy of strip triangulation. Another objective of the investigation was to study the effect of the number of points on the attainable accuracy and the improvement of the attainable accuracy by using the numerical relative orientation with properly weighted parallax observations and comparing the results with unweighted parallax observations in the model. Finally, a comparative study between experimental results and the corresponding theoretical values is presented in this paper. Numerical relative orientation using 6 and 9 points for performing the relative orientation has been used in this investigation. Dissert. Abstr.

N69-20181# Dickey (Clyde W.), State College, Pa.
DEVELOPMENT OF TECHNIQUES FOR THE DESIGN AND FABRICATION OF SEISMIC MODEL RECEIVING TRANSDUCERS Final Report, 17 Apr.–20 Dec. 1968
Clyde W. Dickey Dec. 1968 49 p refs
(Contract F19628-68-C-0273)
(AD-680830) Avail: CFSTI CSCL 14/2

Ferroelectric ceramic transducer materials were investigated to determine their application to the design and fabrication of seismic model receiving transducers. Selected materials were used in the fabrication of (1) normal and (2) transverse displacement sensors. The sensors exhibit broad bandwidths and high sensitivity to preferred displacements while affording discrimination against unwanted modes of vibration. Author (TAB)

N69-20300*# Norton Research Corp., Cambridge, Mass.
DEVELOPMENT OF AN ACCURATE WIDE RANGE ULTRA HIGH VACUUM GAUGE CALIBRATION METHOD, 29 JUNE 1966–28 FEBRUARY 1968
Peter Fowler and F. J. Brock 28 Feb. 1968 85 p refs
(Contract NAS5-9348)
(NASA-CR-100367) Avail: CFSTI CSCL 14B

A calibration method was developed and parts for an ultrahigh vacuum prototype calibration system for ion gauge and mass spectrometers to cover the range 10^{-6} to 10^{-15} torr were constructed and evaluated. The method applies pressure attenuation, molecular beam, and cryopumping techniques to a system; such that, in a volume having extremely low background density, a molecular beam is formed having a precisely known density which is variable over the useful range of operation. The conductance of the porous Vycor plug attenuator was determined for various gases and for various temperatures. The variation of gas flow through near ideal orifices was investigated over a range of Knudsen numbers from 22 to 0.5. The ultimate pressure in the cryopumped molecular beam tunnel was determined for the beam off, and the gas density distribution and signal to background gas density ratio with the beam on was determined for various values of the beam orifice Knudsen number. Author

N69-20373# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR DYNAMIC TESTING OF METALS AND ALLOYS IN LIMITED HEAT CARRIERS AT HIGH PRESSURES AND TEMPERATURES
Yu. F. Bychkov, I. D. Laptev, and A. N. Rozanov Apr. 1968 10 p refs Transl. into ENGLISH from Met. i Metalloved Chistykh Metallov (USSR), no. 5, 1966 p 199–203
(AD-680941; FTD-HT-23-1579-67) Avail: CFSTI CSCL 11/6

The article gives details of a unit permitting corrosion tests of metals and alloys in organic heat transfer media at temperatures up to 400-450C, pressures up to 50 atm, and calculated velocities from 1.4 to 5.7 meters/sec. The unit has been used successfully under the following experimental conditions: temperature 320C; pressure 8 atm; organic heat transfer medium--monoisopropyldiphenyl with 0.1% water; duration of operation--500 hours. Author (TAB)

N69-20446# Harvard Coll. Observatory, Cambridge, Mass.
RESEARCH DIRECTED TOWARD THE INVESTIGATION OF SOLAR SURFACE STRUCTURES BY MEANS OF SPECTROHELIOGRAPH TECHNIQUES Final Report, 10 Jun. 1967–10 Oct. 1968
Alan Title Nov. 1968 15 p refs
(Contract F19628-67-C-0374)
(AD-681177; AFCRL-68-0634) Avail: CFSTI CSCL 14/5

The report describes a system - the Spectraspectroheliograph - for obtaining two dimensional arrays of spectra and recombining them into spectroheliographs. The technique required the development of a high speed framing camera with a 20:1 exposure to advance cycle. The camera design concepts are outlined. During the summers of 1967 and 1968 the system was operated at Sacramento Peak and Kitt Peak Observatories, respectively. The data obtained is catalogued; the data reduction procedures that have been developed are described; and the present plans for analysis are outlined. Author (TAB)

N69-20467*# Inertia Switch Ltd., Camberley (England).
WATER DEPTH AND SLUSH DRAG INSTRUMENTATION
W. W. H. Clarke *In* NASA. Washington Pavement Grooving and Traction Studies 1969 p 213–234 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 01E

The equipments which were developed for measuring water depth on runways and for measuring the drag due to slush residue are described and their calibrations and application are outlined. The test evaluation programs are assessed. The forms in which information regarding runway conditions can be presented to the operational user are described and related to modern airport practice. In the case of water depth measurements the relevance of water depth instrumentation is discussed in the light of grooving techniques and of high rainfall rate possibilities and cross winds. In the case of slush drag the importance of predicted drag and its effect on typical aircraft takeoff distance is illustrated by theoretical calculation. Some attention is given to the nature of slush, and the significance of conditions in which enhanced drag may be encountered is examined. Author

N69-20516# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Lab.
AN EXPERIMENTAL IN SITU DENSITOMETER
Howard W. Kuenzler (M.S. Thesis) Sep. 1968 59 p refs
(Contract Nonr-1841(74))
(AD-681090; MIT-68-3) Avail: CFSTI CSCL 8/10

A new prototype transducer capable of making direct measurements of fluid density in situ has been developed. The theory of design, the method of construction, and the performance in laboratory tests are discussed in view of its possible application as an oceanographic tool for precise measurement of seawater density. Present sensitivity is within an order of magnitude of the capabilities of indirect techniques currently being used for seawater. Suggestions are made for improving the precising, and indications are given that the device has potential as a sea-going oceanographic instrument. Author (TAB)

N69-20639*# Lockheed-Georgia Co., Marietta. Nuclear Lab.
LH_2 QUALITY METER Final Report
Oct. 1968 56 p refs
(Contract NAS8-20518)
(NASA-CR-100356) Avail: CFSTI CSCL 14B

Two engineering test models, fabricated from aluminum and from 347 stainless steel, were tested and calibrated in accordance with specified operating conditions and accuracy. The device was designed to indicate the ratio of dry vapor to wet vapor being vented through itself. Overall instrument length was approximately 13 inches, and its weight was about 15 pounds. The electronic compartment, which also contained the temperature stabilized pressure transducer, contained some 250 electronic parts on 8 printed circuit boards, and is attached to the beta gage section with a thermally insulating Kel-F ring. Heat loss through this ring is approximately 3.5 watts with a 500°F temperature differential

across it. Quality testing of the two models of the quality meter was performed; failures occurred during vibration testing, electromagnetic interference testing, and when the original ORTEC surface barrier detector was cycled with liquid hydrogen. B.P.

N69-20612# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

MEASUREMENT, WITH STEADY PRESSURE RISE, OF THE PERMEABILITY OF A GAS THROUGH A POROUS MEMBRANE [MESURE, EN MONTEE CONTINUE DE PRESSION, DE LA PERMEABILITE D'UN GAZ A TRAVERS UNE MEMBRANE POREUSE]

Maurice Davion Jan. 1969 27 p refs In FRENCH; ENGLISH summary

(CEA-R-3658) Avail: CSFTI

This study concerns a device for following the variations in the permeability of a gas across a porous membrane as a function of the average pressure, P, applied to the membrane from which is deduced a value of an equivalent porous radius. A constant gas flow is introduced into an enclosure separated into two compartments by the membrane and the simultaneous variations of the pressure in the enclosure and of the pressure difference δP between the two compartments are measured. After a transient period, δP is given by an asymptotic expansion as a function of a dimensionless variable, w, which includes several parameters (ratio of the compartment volumes, physical properties of the gas, pore radius, value of δP in the steady state) and the variable pressure P. When w is large compared to unity, the condition which gives an upper limit to the flow for a given membrane, the expansion is practically equal to its first term; the changes in P and in the permeability are then inversely proportional. The perturbing influences of various secondary effects (e.g. changes in the enclosure temperature) on the pore radius measurement are estimated. Author (ESRO)

N69-20615# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

CONSTRUCTION OF AN ENERGY SELECTOR FOR SLOW ELECTRONS [REALISATION D'UN SELECTEUR D'ENERGIE POUR ELECTRONS LENTS]

Serge Chatel Sep. 1968 41 p refs In FRENCH; ENGLISH summary

(CEA-R-3546) Avail: CFSTI

The principles involved in the construction of homokinetic electron selectors and the difficulties arising at low energies are discussed, and the equipment built by certain experimenters is reviewed. A description is given of a selector consisting of a cylincrical condenser with an angle of $\Pi/2$ which can be fitted to a mass spectrometer. The measurements carried out with an analyzer identical to the selector show the separating power to be between 0.12 and 0.14 V for energies of between 6 and 42 V. Author (ESRO)

N69-20626# Army Foreign Science and Technology Center, Washington, D. C.

PHOTOELECTRIC GUIDING SYSTEMS AND FINE CORRECTION SYSTEMS OF THE AZT-15 AND AZT-16 TELESCOPES

E. D. Karabash, R. N. Loparev, P. V. Nikolaev, O. V. Popov, and Yu. A. Sabinin 1968 21 p refs Transl. into ENGLISH from the book "Electric Drive and Control System" Moscow, Nauka, 1968 p 158–171

(AD-680803; FSTC-HT-23-190-68) Avail: CFSTI CSCL 17/8

The AZT-15 and AZT-16 telescopes, their optical systems, photoelectric guiding system, and associated high voltage electronic equipment are discussed in detail. In particular the photoelectric guiding system and photomultipliers are treated to special attention. The systems were designed for the purpose of tracking stars of the 8th and 9th magnitude. Author (TAB)

N69-20676# Library of Congress, Washington, D. C. Aerospace Technology Div.

GROUND BASED SENSORS

George Steblez 10 Jan. 1969 21 p refs

(AD-680839; ATD-69-10; Rept-2) Avail: CFSTI CSCL 17/5

Based on a Soviet literature review, several developments pertaining to ground based sensors were reported. Devices for infrared spectra studies included reflector-refractor objective lens, evaporographic converter, wide-angle lens thermophotographic equipment based on use of linear thermal battery and photoelectro-optical amplifier, image reproduction apparatus, radiation detector for a wide spectrum interval, emission measuring device, electrochemical device for memorizing and reproducing images, and an evaporograph for investigation of the energy field of pulsed radiation sources. Also discussed were infrared image display methods, aberration of two-lens objective in the infrared region and three-component optical system with variable focal length for the infrared region. Selenium photocells with heterojunctions sensitive in the near-infrared region and electroluminescence screen with comb-shaped electrodes were considered. B.G.D.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N69-19647*# Borg-Warner Corp., Bedford, Ohio. Pesco Products Div.

DESIGN, FABRICATION AND TESTING OF A DESTRATIFICATION MOTOR-IMPELLER UNIT Final Report, Period Ending 15 Feb. 1969

J. R. Hamm 15 Feb. 1969 159 p refs /ts Eng. Rept. No. 3620

(Contract NAS9-7770)

(NASA-CR-99570) Avail: CFSTI CSCL 13K

Oxygen compatibility was demonstrated by the testing conducted in high pressure gas. Data and supporting remarks covering this portion of the program are included. Achievement of a unit output flow exceeding 1.3 cfm in any required pumped fluid was realized, and is shown graphically. Life testing was completed without incident. A total of almost 700 hours running and 13,500 start/stop cycles on three identicial units, each operating in a different fluid, clearly demonstrate high reliability and extended operational life. Supporting data for the life tests are included. Author

N69-19775*# Franklin Inst., Philadelphia, Pa. Research Labs.

HIGH PERFORMANCE TURBOALTERNATOR AND ASSOCIATED HARDWARE. 3. DESIGN OF BACKUP GAS BEARINGS

W. Shapiro, J. T. McCabe, T. W. Chu, and V. Castelli Washington NASA Feb. 1969 150 p refs Prepared for Pratt and Whitney Aircraft
(Contract NAS3-6013)
(NASA-CR-1292; F-B2263; PWA-3070-Vol-3) Avail: CFSTI CSCL 13I

A detailed description of a program is presented for the analysis and design of a gas (argon) bearing system for a Brayton cycle turbo-alternator that produces electric power in a space vehicle. Because of the complex nature of the lubrication problem, the analysis was accomplished by numerical methods programmed on a digital computer. For both the thrust and journal bearings, steady-state and dynamic analyses were accomplished. The steady-state results provided parametric performance over a wide range of operating conditions. The more complicated and lengthy dynamic analysis was used to establish the stability of the bearings and bearing-rotor system using geometric variables selected on the basis of steady-state results. Steady-state performance of both the journal and thrust bearings is considered excellent and stability characteristics of the journal bearings are marginal. Author

N69-19786*# Hydronautics, Inc., Laurel, Md.
EXPERIMENTAL AND ANALYTICAL INVESTIGATIONS ON MULTIPLE LIQUID IMPACT EROSION
A. Thiruvengadam and S. L. Rudy Washington NASA Mar. 1969 102 p refs
(Contract NASw-1608)
(NASA-CR-1288; TR-719-1) Avail: CFSTI CSCL 11F

Results are summarized concerning the erosion of 1100-O aluminum and 316 stainless steel. A rotating-disk facility was used to test six specimens simultaneously at three different velocities. High speed and conventional motion pictures with stroboscopic illumination were taken to show the qualitative phenomenon of liquid jet impact. The threshold impact velocity at which erosion was observed after ten million impacts was determined. The threshold water hammer stress on the material corresponding to this threshold velocity was correlated with the high frequency endurance limit corresponding to ten million fatigue cycles using the magnetostriction vibratory apparatus. The ratio between the fatigue endurance limit and the water hammer stress is 1.7 for the aluminum and 3.0 for the stainless steel. A mathematical theory to predict the rate of cavitation erosion as a function of exposure time was extended to multiple liquid impact erosion. The results indicate that the peak rate of erosion varies as the fifth power of the velocity of impact; the observed time of the peak rate varies as the one-fifth power of the impact velocity. Scanning electron microphotographs of specimens eroded both by cavitation and by liquid impingement were compared, and an apparent similarity in the material removal processes further justifies the use of a common theory. K.W.

N69-19800*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland Ohio.
FRICTION AND WEAR OF NINE SELECTED POLYMERS WITH VARIOUS FILLERS IN LIQUID HYDROGEN
Donald W. Wisander and Robert L. Johnson Washington Mar. 1969 20 p refs
(NASA-TN-D-5073) Avail: CFSTI CSCL 11I

Experiments were conducted with a 0.1875-inch- (0.476-cm-) radius hemisphere of nine polymers in sliding contact with a rotating 17-4 PH disk in liquid hydrogen. Sliding velocity was 2300 feet per minute (701 m/min) at a load of 1 kilogram. Results indicate that several filled polymers show promise. Graphite-filled polyamide (nylon), graphite filled and glass-fiber-filled polytrifluorochlorethylene (PTFCE), and a 50-percent polytetrafluoroethylene (PTFE)–50-percent polyparaphenyl have friction and wear similar to filled-PTFE composites commonly used in cryogenic applications. Author

N69-20800# Centre d'Etudes et de Recherches en Technologie Spatiale, Toulouse (France).
INTRODUCTION TO FRICTION AND LUBRICATION IN SPACE [INTRODUCTION A L'ETUDE DU FROTTEMENT ET DE LA LUBRICATION DANS L'ESPACE]
J. C. Hennequin Nov. 1968 143 p refs In FRENCH
(CERTS-NT-03-2) Avail: CFSTI

After recalling the mechanical and surface properties of materials the different hypotheses of sliding friction are discussed e.g. Parent, Tomlinson, Bowden and Tabor, Ernst and Merchant theories and emphases is laid on the mechanism of lubrication. The mechanical, physical and chemical properties of lubricants suitable for space application are discussed in detail. Author (ESRO

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N69-19991 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
ELECTRODYNAMICS OF MEDIA
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 55–68 refs (See N69-19981 09-34)
(Contract DA-28-043-AMC-02536(E))
Avail: CFSTI

If we apply the formula for the saturation power of a two-level system to the case of CO_2, using for the relaxation time of the upper level the value 10^{-3} sec, for the lower level 10^{-4}, and $t_{sp}=5$ sec, we obtain a value that is too small compared with the experimentally observed value by a factor of 500 or 100, the value depending on the experiment that is used for comparison. In this report, we determine the cross relaxation of the rotational levels, by solving in closed form the rate equations in the limit when the vibrational relaxation times are long compared with the rotational relaxational times, a situation that holds in practice. It may be shown that the number of levels participating in CO_2 laser action is of the order of 15. Hence the discrepancy between the theoretically predicted value for the saturation power and the one observed experimentally cannot be explained solely by assuming cross relaxation of the rotational levels. We propose that the discrepancy can be explained by further assuming spatial diffusion of the unused populations into the laser beam, and we estimate the magnitude of this effect. Author

N69-20128 Purdue Univ., Lafayette, Ind.
THE PROPAGATION OF A LASER BEAM IN A TURBULENT ATMOSPHERE WHOSE REFRACTIVE INDEX FLUCTUATIONS ARE GAUSSIAN CORRELATED
Thomas Joseph Gilmartin (Ph.D. Thesis) 1968 168 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-12554

A confocal laser oscillating in the TEM_{00} mode generates a beam within the cavity which has a Gaussian intensity profile at the output aperture. This source gives rise to a beam of arbitrary divergence. The expression for this beam in a homogeneous medium is derived in detail, and the approximations which are involved in the derivation are thoroughly examined. The refractive index inhomogeneities characteristic of a turbulent atmosphere are introduced into the wave equation as a small random perturbation of the dielectric constant. The solution of this equation is obtained

by applying an iterative procedure in which the expression for the beam in a homogeneous medium is used as the zeroth-order approximation and higher order corrections represent scattered waves.
Dissert. Abstr.

N69-20137# Army Electronics Command, Fort Monmouth, N. J.
THERMAL EFFECTS IN CARBON DIOXIDE LASERS
Hermann W. Brinkschulte Oct. 1968 25 p refs
(AD-680897; ECOM-3030) Avail: CFSTI CSCL 20/5

Gas temperature and its distribution across the laser tube were calculated from a simple energy equation. The calculations were carried out for CO2 and CO2-He-discharges. The necessary thermal conductivities for CO2-CO- and CO2-He-mixtures were determined for 300K and 400K. Good agreement has been found between the calculated temperatures and the spectroscopically determined values. Comparison of a CO2 and or CO2-He discharge indicates that He does not lower the gas temperature significantly. However, the maximum of laser emission at the P(22) line in CO2 is shifted to the P(20) line in CO2-He mixtures. Author (TAB)

N69-20267# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL RESEARCH ON THE PASSAGE OF LIGHT PULSES THROUGH A RESONANT MEDIUM
R. S. Kostanyan et al 5 Apr. 1968 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Arm. SSR (Erevan), v. 43, 1966 p 268–271
(AD-680943; FTD-HT-23-1583-67) Avail: CFSTI CSCL 20/5

The work covers experimental research on the energy characteristics of light pulses passing through a resonant medium (a traveling wave amplifier). The dependence of the amplification (attenuation) factor on the input-pulse energy per unit surface, the population of the working levels of the medium, and the length of the sample is discussed. Results obtained are compared with theoretical calculations made previously. Author (TAB)

N69-20323 Ohio State Univ., Columbus.
THE LOG-AMPLITUDE MEAN VALUE FOR LASER BEAM PROPAGATION IN THE ATMOSPHERE, WITH APPLICATIONS FOR OPTICAL COMMUNICATIONS
Frederick George Gebhardt (Ph.D. Thesis) 1968 313 p
Avail: Univ. Microfilms: HC $14.20/Microfilm $4.05 Order No. 68-12836

In this study an integral expression is evaluated for the log-amplitude mean value of a Gaussian or laser-like optical beam in a turbulent atmosphere. The expressions presented here for the log-amplitude mean value depend on a strength factor, which is the log-amplitude variance for a point source, and a multiplying factor, which depends on the source beam size. Numerical results for the beam size dependent factor are given for a wide range of beam sizes, wavelengths, and pathlengths. Numerical results are also presented for the mean on-axis intensity and mean beam size, for focused and collimated Gaussian beams, which apply for the design of laser communication systems in the atmosphere. These results are obtained by combining our results for the log-amplitude mean with those for the variance, as obtained by Fried and Seidman. Dissert. Abstr.

N69-20429# Oregon Univ., Portland. Oregon Graduate Center for Study and Research.
MULTIWAVELENGTH LASER PROPAGATION STUDY Quarterly Progress Report, 15 Sep.–15 Dec. 1968
J. Richard Kerr Dec. 1968 18 p refs
(Contract N00014-68-A-0461; ARPA Order 306)
(AD-681346; REPT-1154-2; QPR-2) Avail: CFSTI CSCL 20/5

The major objective of this program is to experimentally investigate the wavelength-dependence of turbulence effects on optical propagation through the atmosphere, and to relate the results to certain meteorological parameters, theoretical models, and model-independent dimensional analyses. The experiments are conducted with the use of simultaneous, spatially-coincident laser beams at three wavelengths in the visible and infrared spectrum, with real-time processing for the various statistical results. During the second period, the low noise, stable lasers were acquired, the three-wavelength transmitter and receiver optical systems were constructed, and the computer electronics were completed. A newly acquired, flat site was established with necessary power, cooling, communications, and protective arrangements. The above systems are currently being installed at the site. The resultant facility will be uniquely suited to atmospheric propagation work, in terms of multiwavelength capability, data processing versatility, meteorological instrumentation, and attention to experimental detail necessary to achieve reliable results in this difficult field of investigation. Author (TAB)

N69-20442# Honeywell, Inc., Hopkins, Minn. Corporate Research Center.
MECHANISMS OF LASER-SURFACE INTERACTIONS Semiannual Report
J. F. Ready and G. E. Bernal Nov. 1968 49 p refs
(Contract DA-18-001-AMC-1040(X))
(AD-680956) Avail: CFSTI CSCL 20/5

This report describes investigations of the mechanisms by which high power laser radiation interacts with absorbing surfaces. Construction of a carbon dioxide laser used in this work is described, along with preliminary spectroscopic observations of the emission produced when this laser radiation interacts with a glass target. Measurements of ion emission produced by a ruby laser beam with flux densities of the order of 1000 megawatts per square centimeter incident on a tungsten target have been analyzed. From the results it is estimated that particle densities of the order of 10 to the 20th power per cubic centimeter are produced near the target surface. A computer program using these particle densities has been employed to calculate the expected amount of heating produced by absorption of the incident laser radiation in a sodium plasma of this density. The results indicate that rapid heating to temperatures of the order of tens of eV is possible within the time of the laser pulse duration. Author (TAB)

N69-20444# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEPENDENCE OF LASER SINGLE-PULSE CHARACTERISTICS ON ACTIVE ROD LENGTH
A. M. Samson Mar. 1968 12 p refs Transl. into ENGLISH from Zh. Prikl Spektroskopii (USSR), v. 5, no. 6, 1966 p 718–723
(AD-680990; FTD-HT-23-1135-67) Avail: CFSTI CSCL 20/5

The dependence of population inversion on rod length in the case of ruby and neodymium glass laser rods was investigated. The required pumping rates at a given rod length increase with gain in a nonlinear manner. The population inversion drops with increasing rod length. The formulas describing the above relationship make it possible to estimate the total energy stored in a rod of certain length at any pumping input. The energy storage curves as a function of rod length reach their maximum and level off at rod lengths of 10 to 20 cm for both ruby and glass. The radiation power as a function of rod length, however, shows a maximum around the 10-cm rod length and then diminishes with longer rods because of the Fresnel reflection from the ends. The most efficient laser action, according to the calculations, can be achieved with

rapid (about 1 to 10 nsec in 3- and 4-level lasers) Q-switching, provided the dependence of emitted power on the coefficient of useful losses is investigated and the position of its maximum is determined. TAB

N69-20479# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A 1 GW NEODYMIUM GLASS LASER

A. A. Mak et al. 18 Apr. 1968 5 p ref Transl. into ENGLISH from Opt.-Mekh. Prom. (Leningrad), v. 34, no. 10, 1967 p 63–64

(AD-681257; FTD-HT-23-300-68) Avail: CFSTI CSCL 20/5

The system consists of a master laser and a two-stage laser amplifier. The master-laser head comprises a neodymium glass rod 20 mm in diameter and 260 mm long, an IFP-5000 2-kj flashlamp, and a cylindrical pump reflector. The amplifier heads are identical and in each case the active rod is bathed in an aqueous solution of sodium nitrite to retard uv-induced aging of crystals and to reduce thermal stresses. The output of the 100-cm-long resonator was passed through a 30% reflective stack and the Q-switching was done by means of a rotating prism (30,000 rpm) and a plane-parallel plate with an end reflector which also served as an angular selector. The master laser operated in the free-running mode at an efficiency of 3.5%, generating 140-150 MW 70 nanosec pulses with a 3-5 min of arc beam divergence. Seventy nanosec 500 MW and 1 GW pulses were obtained at the first and second (output) stages, respectively, for an 80 MW input. Author (TAB)

N69-20514# Ballistic Research Labs., Aberdeen Proving Ground, Md.

SATURATION OF SCINTILLATION MAGNITUDE IN NEAR-EARTH OPTICAL PROPAGATION

Paul H. Deitz and Neal J. Wright Oct. 1968 45 p refs Supersedes BRL-MR-1941

(AD-681352; BRL-MR-1941-Rev; BRL-MR-1941) Avail: CFSTI CSCL 20/6

Both a pulsed laser and a helium-neon laser have been used as optical sources to examine the magnitude of scintillation as a function of range and strength of turbulence over a near-earth, horizontal path. A photo-optical technique was utilized to record directly a 61-cm cross section of a received laser beam. Photographs of beam cross sections made at ranges of from 200 to 1500 m were used to compute log-intensity variances. Simultaneous with the optical data, measurements of the index structure coefficient Cn were made through a high-speed thermal technique. The data are used to test the spherical wave equation giving the log-amplitude variance as a function of range and Cn. The measurements indicate that the variance increases for ranges up to about 700 m, at which distance saturation occurs. The data are also compared with the saturation equations of Tatarski and deWolf. In addition, the effect of the transmitter beam divergence on the magnitude of scintillation is examined. Finally, a modification of the inertial subrange of the Kolmogorov turbulence model is suggested to explain the occurrence of particular optical effects observed during temperature inversion conditions. Author (TAB)

N69-20535# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.

STIMULATED BRILLOUIN SCATTERING AND LASER DAMAGE OF OPTIMAL MATERIALS, PART 1 Final Report, Oct. 1966–Oct. 1968

Chung L. Tang 30 Oct. 1968 24 p refs

(Contract AF 19(628)-5677)

(AD-681124; AFCRL-68-0598) Avail: CFSTI CSCL 20/6

A detailed steady state theory of the stimulated Brillouin process has been developed and tested extensively experimentally using various liquids and fused quartz at room temperature. The principal results obtained are summarized in this report. Preliminary experimental results demonstrating the importance of the transient effects in the process under certain conditions have also been obtained and discussed here. Finally, the problem of laser damage of normally transparent optical materials is also briefly considered on the basis of the results obtained on the stimulated Brillouin process. Author (TAB)

N69-20545# Radiation Research Associates, Inc., Fort Worth, Tex.

SCATTERING AND REFLECTANCE OF LIGHT FROM AIRBORNE LASER SYSTEMS

Dave G. Collins and Michael B. Wells Jun. 1968 77 p refs

(Contract F19628-67-C-0298)

(AD-681145; RRA-T88; SR-4; AFCRL-68-0478) Avail: CFSTI CSCL 20/5

The LITE-I Monte Carlo program was used to predict the ground reflected and atmospheric scattered components of the scattered light from airborne laser systems received at collimated receivers located at the same altitude as the laser system and focused on the ground area illuminated by the direct radiation from the laser system. Lasers emitting light with wavelengths of 0.5145, 1.06, 3.507 and 10.6 microns were considered at different altitudes in two model atmospheres. The first atmosphere was a clear atmosphere having a ground level meteorological range of 25 km. The second atmosphere was identical to the first above 1.5 km but below 1.5 km the aerosol content was increased to reduce the ground level meteorological range to 5 km. The ground reflected component of the scattered light entering the receiver for all four wavelengths was taken to be the sum of the direct radiation incident on the ground and reflected to the receiver plus the single scattered radiation incident upon the ground area illuminated by the direct radiation and then reflected to the receiver. For the 3.507 and 10.6 micron lasers the atmospheric scattered component at the receiver in both atmospheres is composed almost entirely of single scattered light, but for the 0.5145 and 1.06 micron lasers the single scattered irradiance seriously underpredicts the atmospheric scattered component for lookangles greater than just a few degrees. Author (TAB)

N69-20558# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SUPPRESSING CERTAIN MODES IN RUBY-LASER RADIATION

V. R. Berezovskiy et al. 9 Apr. 1968 8 p refs Transl. into ENGLISH from Soobshcheniya Akad. Nauk Gruzin. SSR (Tiflis), v. 45, no. 2, 1967 p 333–336

(AD-680944; FTD-HT-23-1600-67) Avail: CFSTI CSCL 20/5

A comparison was made of radiation spectra of the quantum generation of a laser composed of several segments with the radiation spectrum of a one-piece laser. TAB

N69-20572# Air Force Cambridge Research Labs., Bedford, Mass.

MEAN-FIELD KINETIC EQUATIONS FOR A LASER

Richard H. Picard Aug. 1968 121 p refs *Its* Phys. Sci. Res. Papers No. 381

(AD-681103; AFCRL-68-0400) Avail: CFSTI CSCL 20/5

A set of kinetic equations is derived for a single-mode laser based on the assumption that the mean optical field of the laser model need not vanish. They constitute a coupled system for the field and single-atom density operators and are obtained from the quantum-Liouville equation by a generalization of the method

of Bogolyubov. The equations are derived to second order in the matter-field coupling constant, assuming an asymptotic state with no matter-field correlations. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N69-19607*# McDonnell-Douglas Co., Newport Beach, Calif. Astropower Lab.

STRESS CORROSION CRACKING OF TITANIUM ALLOYS AT AMBIENT TEMPERATURE IN AQUEOUS SOLUTIONS

Quarterly Progress Report, Oct.–Dec. 1968

T. L. Mackay Jan. 1969 22 p refs

(Contract NAS7-488)

(NASA-CR-100314; SM-49105-Q8) Avail: CFSTI CSCL 11F

Aging of beta forged Ti–8Al–1Mo–1V in the temperature range 900°F to 1100°F reduced fracture toughness and increased susceptibility to stress corrosion cracking. Selected area diffraction of beta forged Ti–8Al–1Mo–1V showed a face-centered tetragonal for martensitic alpha phase and coplanar slip was shown to be associated with |111| planes. Aging of martensitic structure reduces the amount of retained beta. The reduction in fracture toughness of aged alpha–beta alloys appears to be highly dependent on the microstructure of the beta phase in aged heat treat condition. Specimens of the titanium alloys, Ti–8Al–1Mo–1V, Ti–4Al–1Mo–1V and Ti–4Al–1.5Mo and 0.5V were irradiated with thermal neutrons. A technique for observing Mo^{99} distribution in titanium alloys was developed employing NTB–3 nuclear track emulsion. The effect of a stress field on the distribution of tritium in beta forged Ti–8Al–1Mo–1V at 600°F was determined. An increasing concentration of tritium at the alpha–beta interface with increasing stress field was observed. Author

N69-19614# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

NIOBIUM–1 PERCENT ZIRCONIUM BOILING-POTASSIUM FORCED-CIRCULATION LOOP TEST

D. H. Jansen, J. H. DeVan, C. W. Cunningham, L. C. Fuller, and R. E. Mac Pherson Dec. 1968 123 p refs

(Contract W-7405-ENG-26)

(ORNL-4301) Avail: CFSTI

A Nb–1% Zr boiling-potassium forced-circulation loop, incorporating a test section with three stages of nozzles and simulated turbine blades, was operated for 3000 hr. The nozzles were designed to provide potassium vapor over the quality range of 83 to 97% and temperature range of 1016° to 682°C to impinge on the Nb–1% Zr simulated blade specimens. Potassium vapor at the test section inlet was normally maintained at 1082°C, but periods of unstable boiling with resultant loop temperature fluctuations occurred throughout the loop operation. Surfaces throughout the loop were unchanged as a consequence of potassium exposure except for the second-stage blade specimen. This blade specimen had been subjected to relatively high-velocity and wet vapor during the test. The leading edge of this specimen was roughened to a depth of 0.001 in. Oxygen transfer from the potassium bath to the Nb–1% Zr alloy was observed. The greatest increase occurred in the hotter loop region. Author (NSA)

N69-19633# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

CORROSION AND FAILURE CHARACTERISTICS OF ZIRCONIUM ALLOYS IN HIGH-PRESSURE STEAM IN THE TEMPERATURE RANGE 400 TO 500 DEG C

A. B. Johnson, Jr. Sep. 1968 25 p refs Presented at the Appl.-Related Phenomenon of Zirconium and Hafnium Symp., Philadelphia, Pa.

(Contract AT(45-1)-1830)

(BNWL-SA-1929-PT-2-Rev; CONF-681105-2) Avail: CFSTI

A nuclear fuel failure phenomenon prompted a study of the corrosion properties of the Zircaloy-2 fuel cladding. The principal studies were conducted at 400, 450, 475 and 500°C in steam at 1700 psig. Materials tested were: five lots of Zircaloy-2; one lot of Ozhennite (Zr–0.2Sn–0.1Fe–0.1Ni–0.1Nb) and one lot of crystal bar zirconium. As-fabricated Zircaloy-2 underwent a rapid approach to failure in tests at 475 and 500°C. The attack involved nucleation of nodular oxide which spread across the surface, finally resulting in an accelerated, relatively uniform attack. Ozhennite was resistant to the attack. Heat treatments (α and β anneals) suppressed the nodular attack on Zircaloy-2 but not on crystal bar zirconium. Author (NSA)

N69-19634# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

FATIGUE CRACK GROWTH AND PROPAGATION IN ZR-2.5 WT. PERCENT NB ALLOY PRESSURE TUBING

P. J. Pankaskie 10 Sep. 1968 22 p refs Presented at the Appl.-Related Phenomenon of Zirconium and Hafnium Symp., Philadelphia, Pa.

(Contract AT(45-1)-1830)

(BNWL-SA-1821; CONF-681105-3) Avail: CFSTI

Zr–2.5 wt% Nb alloy tubes were fatigued in the tension-tension mode by cyclic internal pressures to cause axial crack growth and unstable fractures at room temperature. Pressure cycle rates were 400 and 3000 cycles per hour. Both the cold worked and heat treated conditions, before and after hydriding (200 to 300 ppM H_2), were investigated. Tests were used to determine the effect of the axial length of the surface stress intensifying defect, and multiple surface stress intensifying defects on fatigue crack initiation growth and critical length at unstable fracture. Fatigue crack initiation and growth were found to occur at nominal peak hoop stresses equal to or less than the estimated endurance limit (≈25,000 psi). For fatigue cracks initiated at the outside diameter surface, the shape of the crack front is semicircular. The number of stress cycles required to initiate fatigue cracking at the surface is inversely proportional to the square of the surface defect length. Crack growth rates for non-hydrided tubing are proportional to ΔK to the fifth power, and to ΔK to the fourth power after hydriding. Critical crack length at unstable fracture decreased with an increase in the number of fatigue cycles required to initiate fatigue cracking. Multiple defects may act to initiate unstable fracture. Fracture toughness of the heat treated tubing before hydriding is less than for the cold worked condition either before or after hydriding, and after hydriding the fracture toughness is further reduced. Author (NSA)

N69-19677*# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.

ENHANCED GRAIN BOUNDARY SLIDING DURING REVERSED CREEP OF LEAD

Masaki Kitagawa Oct. 1968 37 p refs

(Grant NGR-14-005-025)

(NASA-CR-100316; T/AM-319) Avail: CFSTI CSCL 11F

Chemical lead is subjected to multiple creep stress reversals at room temperature, 100 C and 150 C, and the alterations in grain structure are examined. Creep deformation resistance at these

test temperatures decreases significantly under multiple stress reversals. However, the decrease in creep resistance caused by reversed stressing is smaller when the test temperature is increased above about half of the melting point of the metal. Significant microstructural changes are observed during reversed creep. Grain boundaries are found to migrate toward planes of maximum shear stress, resulting in an orthorhombic grain structure. The formation of this unusual grain structure is discussed in relation to creep resistance changes due to reversed stressing. To support the discussion, grain boundary sliding during reversed creep was measured. The contribution of grain boundary sliding to the total creep strain is found to greatly increase as the orthorhombic grain structure is formed. Author

N69-19709# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
RECENT ADVANCES IN THE PRODUCTION OF MIXED, SINGLE-PHASE SINTERED CARBIDES (U-Pu)C [RECENT PROGRES DANS LA FABRICATION DES CARBURES MIXTES (U-Pu)C MONOPHASES FRITTES]
Robert Lorenzelli and Pierre Petit Sep. 1968 35 p refs In FRENCH; ENGLISH summary
(CEA-R-3603) Avail: CFSTI

Carbides sintered with nickel are dense but contain about 10 per cent M_2C_3, whilst those sintered without nickel are less dense but contain almost nearly no M_2C_3. In dense carbides, the M_2C_3 is linked to the oxygen and nitrogen content of the carbides. However, in less dense carbides, the M_2C_3 can be eliminated through the reaction: $2M_2C_3 + MO \rightarrow 5MC + CO$, the CO escaping due to porosity. The difference between the two types of carbides is due to the fact that the accelerated compaction observed when nickel is used as a sintering aid prevents the CO from escaping. Author (ESRO)

N69-19736 Florida Univ., Gainesville.
AN ELECTRON MICROSCOPE AND FIELD ION MICROSCOPE STUDY OF DEFECTS IN QUENCHED PLATINUM
Robert William Newman (Ph.D. Thesis) 1967 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-13022

Results of a survey study of the secondary defects existing in quenched platinum are presented. Transmission electron microscopy used in conjunction with field ion microscopy has yielded direct experimental evidence for the existence of prismatic dislocation loops (both glissile and sessile) as well as polyhedral voids. Small tetrahedral voids have been discovered in field ion specimens, and it is postulated that these clusters are the nuclei for both voids and dislocation loops, depending upon the number and efficiency of the vacancy sinks in the local environment. The voids are shown to be extremely stable almost to the melting point. Dissert. Abstr.

N69-19768*# Boeing Co., Seattle, Wash. Aerospace Group.
FRACTURE CHARACTERISTICS OF 6AL-4V TITANIUM ALLOY FORGINGS CONTAINING ALPHA STRINGER MICROSTRUCTURE Final Report, 10 Sep. 1968-24 Jan. 1969
W. D. Bixler Jan. 1969 55 p ref
(Contract NAS9-8809)
(NASA-CR-99512; D2-121005-1) Avail: CFSTI CSCL 11F

Mechanical properties, plane strain fracture toughnesses, and plane strain sustained and cyclic load flaw growth characteristics were obtained for 5AL-4V titanium forgings with and without alpha stringers. Sustained load tests were conducted in environments of nitrogen tetroxide, Aerozine 50 and Freon TF at a nominal temperature of 80°F while all other tests were performed in air at room temperature. It was concluded based on these test results that the fracture characteristics are not degradated by the presence of alpha stringers. Only the ductility was significantly different in the forging containing alpha stringers. Author

N69-19812 Pennsylvania State Univ., University Park.
INVESTIGATION OF TWIN AND GRAIN BOUNDARY ENERGIES IN STAINLESS STEEL AND INCONEL BY ELECTRON TRANSMISSION AND DIFFRACTION MICROSCOPY
Lawrence Eugene Murr 1967 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-8726

Coherent twin-grain boundary intersections in thin films of annealed 304 stainless steel and Inconel (76% Ni, 16% Cr) were examined by transmission and diffraction electron microscopy. Standard electron diffraction and Kikuchi line techniques were combined with electron transmission image data in a computer program to obtain twin/grain boundary energy ratios. It is shown that a three-dimensional analysis of twin-grain boundary intersections produces mean energy ratios which differ by a factor of two from results obtained by optical microscopy of surface traces, and also yields a greatly reduced spread of individual energy ratio values. It is also shown that negative values of the twin/grain boundary energy ratio obtained by optical measurement of boundary surface traces are invalid, and simply reflect the errors inherent in a two-dimensional approximation of the intersection of boundary planes in three-dimensions. The mean twin/grain boundary energy ratios computed for stainless steel and Inconel both coincided at the value of 0.034. Dissert. Abstr.

N69-19827*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A METHOD FOR CHARACTERIZING THE SURFACE CLEANLINESS DURING ADHESION TESTING
James H. Bradford, Jr. Washington Mar. 1969 45 p refs
(NASA-TN-D-5055) Avail: CFSTI CSCL 11F

It has been shown that the degree of adhesion of metals depends upon the surface cleanliness. The paper presents a method that was used to characterize the surface cleanliness of nickel during an adhesion experiment. The change in the work function of the surface as the metal was cleaned was used to indicate the degree of cleanliness. The point at which the work function was stable with additional cleaning was used as the cleanest surface. The cleaning technique was an argon-ion bombardment and heating process. Measurements showed that the maximum adhesion forces occurred when the surfaces were the cleanest. The cleaned surfaces were recontaminated with oxygen and the adhesion force decreased to zero. Author

N69-19831*# Aerojet-General Corp., Sacramento, Calif.
HYDROGEN GAS PRESSURE VESSEL PROBLEMS IN THE M-1 FACILITIES
J. S. Laws, V. Frick, and J. McConnell Washington NASA Mar. 1969 65 p refs
(Contract NAS3-2555)
(NASA-CR-1305; Rept-8800-67) Avail: CFSTI CSCL 13D

Pertinent data and information are given relating to a series of failures, or structural defects, experienced with high pressure, gaseous hydrogen storage receivers procured for, installed, and used as part of the M-1 Engine Development Program. Author

N69-19832*# Aerotherm Corp., Palo Alto, Calif.
THERMOCHEMICAL ABLATION OF ROCKET NOZZLE INSERT MATERIALS Final Report
Kimble J. Clark, Roald A. Rindal, Lance M. Inouye, and Robert M. Kendall 15 Feb. 1968 131 p refs
(Contract NAS1-7366)
(NASA-CR-66632; REPT-68-29) Avail: CFSTI CSCL 11B

The resistance of potential rocket nozzle throat insert materials to chemical corrosion and melting is considered theoretically for several rocket propellant environments. Surface temperature and recession rate are evaluated for each of twelve materials in each of six propellant environments. The propellants considered include 2 liquids, 2 solids, and 2 hybrids. Potential throat insert materials include carbides, oxides, borides, nitrides, and pure elements. The assumptions embodied in the analysis are identified and the analysis technique is outlined. Superior performing insert materials with respect to corrosion resistance are identified and recommendations for future effort are given. Author

N69-19886*# Varian Associates, San Carlos, Calif.
SOLUBILITY AND DIFFUSION OF OXYGEN IN TANTALUM
M. Parkman, R. Pape, R. McRae, D. Brayton, and L. Reed Washington NASA Feb. 1969 155 p refs
(Contract NAS3-7626)
(NASA-CR-1276; APO-68-1101) Avail: CFSTI CSCL 11F

The solubility of oxygen in tantalum between 600° and 900°C was determined by using a resistivity technique. Carefully reproduced pulses of oxygen were admitted to a high vacuum quartz tube furnace containing a tantalum wire. During each pulse, oxygen was maintained in contact with the specimen for a standard reproduced time after which the oxygen was pumped out and the resistance measured. A plot of change in resistance from the starting value versus number of oxygen charges resulted in a linear curve followed by one or more parabolic curves. The end of the linear section was interpreted to be the phase boundary. Specimens were analyzed by neutron activation to relate change in resistance to oxygen content. Changes in slope of the resistance versus temperature curve for Ta containing between 0.007% and 0.12% oxygen were found at about 450° and 750°C. An anomoly in the curve of resistance versus temperature for oxygen-doped Ta was found at about 900°C. Both of these effects were found in the 2-phase region and appear to be associated with the oxides. Preliminary solubility data were obtained with columbium and Ta–10W alloy. A trial run was made to test a proposed method of measuring diffusion of oxygen in refractory metals. Author

N69-19896 Ohio State Univ., Columbus.
LOCAL DISSOLUTION PHENOMENA OCCURRING ON IRON–CHROMIUM–NICKEL ALLOYS: AN ELECTRON MICROSCOPIC STUDY
James Arthur Davis (Ph.D. Thesis) 1968 131 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-12828

The role of stress in stress corrosion cracking of iron–chromium–nickel alloy was determined. Stress caused the motion of dislocations that ruptured a passive surface film or nickel rich surface. In boiling $MgCl_2$, the unprotected metal exposed by slip is preferentially dissolved. This is the first step in the initiation of stress corrosion cracking. If the walls of the microtrench are cathodically polarized by precipitation of a noble constituent, stress corrosion cracking will occur. Otherwise, the microtrench is repassivated and no further attack occurs until another slip event happens. Preferential dissolution along slip traces as observed by electron microscopy is not a criterion for stress corrosion cracking. Preferential dissolution along slip traces occurs in alloys that do not stress corrode and in environments that do not cause stress corrosion cracking. Dissert. Abstr.

N69-19905 Arizona Univ., Tucson.
A FIELD-EMISSION MICROSCOPE INVESTIGATION OF THE EFFECTS OF AMBIENT ATMOSPHERES ON THE STRESS-CORROSION CRACKING OF URANIUM MOLYBDENUM ALLOYS
Herman Sulsona (Ph.D. Thesis) 1968 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-12922

The effects of heat treatment and ambient atmosphere on the stress-corrosion cracking behavior of U–10 w/o Mo were investigated using a field-emission microscope of cylindrical geometry. Cathodic protection and the effect of static electric DC fields were investigated as possible protective techniques in the stress-corrosion cracking of U–10 w/o Mo. A special "gas shield" protective technique was also investigated. Dissert. Abstr.

N69-19930*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
COMPATIBILITY TESTS OF MOLTEN URANIUM WITH TUNGSTEN AND TUNGSTEN—1.5 PERCENT HAFNIUM
Philip D. Takkunen Washington Mar. 1969 32 p refs
(NASA-TN-D-5076) Avail: CFSTI CSCL 11F

Isothermal compatibility tests were conducted on sealed tungsten (W) and tungsten–1.5-weight-percent hafnium (W–1.5Hf) capsules containing uranium (U) for 10 to 200 hours at 1200° and 1500° C. Extensive intergranular attack was observed in wrought W rod and in vapor deposited W. Hafnium appeared to offer some promise in reducing intergranular attack on W. Single crystal W appeared to be compatible with molten U although some evidence of mass transfer attack was found. In addition, U climbed up the sides of the single crystal capsules and attacked grain boundaries in the closure weld. Cracks were formed in all the capsule walls during cooling after U had solidified. Author

N69-19935*# Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein Jan. 1969 19 p
(Contract NAS7-469)
(NASA-CR-100355; RDR-1534-10) Avail: CFSTI CSCL 11F

The contribution of solutes to the creep strength of columbium–base and tantalum–base alloys is being studied through their effect on the activation energy for creep. H. Near $0.5T_M$ H for unalloyed columbium was found to be a sensitive function of the structure and interstitial concentration. For a constant interstitial concentration H may approach a constant value as the structure approaches a stable configuration. Activation-energy temperature profiles were determined over the temperature range 1800 to 2800°F for the columbium–base alloys Cb–1Zr, C–129Y and C–103. The results obtained thus far indicate that H for these alloys is constant or decreases slightly with increasing temperature. Near 2800°F, however, H for C–129Y and C–103 increases with increasing temperature. Author

N69-19949*# Battelle Memorial Inst., Columbus, Ohio. Columbus Labs.
INVESTIGATION OF THE REACTION OF TITANIUM WITH HYDROGEN Final Report
B. G. Koehl, D. N. Williams, and E. S. Bartlett 18 Mar. 1969 101 p refs
(Contract NAS9-7549)
(NASA-CR-99576) Avail: CFSTI CSCL 11F

An investigation of the reaction between titanium and hydrogen gas was made to determine the factors which promote surface hydriding and methods of preventing it. High-purity hydrogen was

essential for a reaction to occur between titanium and hydrogen gas. At near room temperature and a hydrogen pressure up to 20 psig, a clean, vacuum annealed surface was found to be essential for hydriding. Above 20 psig hydrogen pressure, only abrasion or galling immediately preceding hydrogen exposure was needed to initiate the reaction. An increase in hydrogen pressure or temperature, an acicular microstructure, and oily contamination during galling or abrasion all increased the tendency toward reaction with hydrogen. Reaction was decreased by exposure of specimens to air after abrading or galling and before hydrogen exposure. Stress had no effect in initiating a reaction nor did length of exposure time. In 35 percent dilution welds of Ti-6Al-4V plates using unalloyed titanium (Ti-50A) filler material, no significant evidence of hydrogen embrittlement was found in mechanical property studies, although hydride banding was observed. Author

N69-19967# Bureau of Mines, Reno, Nev. Metallurgy Research Center.

EXPERIMENTAL LEACHING OF GOLD FROM MINE WASTE

Harold J. Heinen and Bernard Porter Apr. 1969 8 p refs
(BM-RI-7250) Avail: Issuing Activity

Excellent gold recovery was demonstrated in a laboratory-scale leaching test on waste material from an open-pit mine in northeastern Nevada. An injection system of leaching was applied in which the sodium cyanide solution was introduced into the interior of the dump at selected points. Dissolution of gold from the waste material, which assayed 0.06 ounce gold per ton, was readily achieved because the gold occurred as submicroscopic particles in a porous host rock. Gold recovery of 80% was obtained in 11 days from material crushed to 1 inch in size, and recovery was 90% after 21 days. Author

N69-19971 Florida Univ., Gainesville.

THE INFLUENCE OF HEAT TREATMENT, NEUTRON IRRADIATION, AND DEFORMATION ON THE MARTENSITIC TRANSFORMATIONS IN METASTABLE BETA 1-BRASS

John Wayne Koger (Ph.D. Thesis) 1967 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-13014

A study was made on the martensitic transformations in metastable β_1-Cu-Zn (with 38.3 to 39.4 wt. percent zinc) to determine the effect of repeated thermal cycling, deformation, annealing, bombardment with fast neutrons, and the presence of untransformable phases on these transformations. The main tool used to monitor the transformations was the measurement of electrical resistance which was complemented by optical and electron microscopy and X-ray diffraction analysis. The principal characteristics of the transformation on cooling, determined from the resistance measurements, were found to be the M_s-temperature, the temperature coefficient of electrical resistivity of the phases, the area of the hysteresis loop of the (percent) transformation curve, and the rate of transformation. Dissert. Abstr.

N69-20029# Aeronautical Research Labs., Melbourne (Australia). Dept. of Supply.

THE EFFECT OF 0.3 PERCENT BY WEIGHT OF SILVER ON THE FATIGUE BEHAVIOUR OF TWO ALUMINIUM-ZINC-MAGNESIUM-COPPER PLATE ALLOYS

A. Vann May 1968 13 p refs
(ARL/SM-326) Avail: CFSTI

Rotating cantilever fatigue tests were carried out on unnotched and notched specimens cut in the short-transverse and longitudinal directions from four Al-Zn-Mg-Cu rolled plates. Two were low-copper (0.45%) and high-copper (1.35%) variants conforming to the specification D.T.D. 5050A whereas the other two contained, in addition, 0.3% wt. of silver. Silver additions appear to have caused no significant increase in the fatigue strength of the alloys in either the unnotched or notched conditions except for the low-copper alloy, for which the unnotched properties in the short-transverse direction of the silver-free alloy were relatively low. Author

N69-20038 Illinois Univ., Urbana.

STAGE 3 ANNEALING IN GOLD AFTER ELECTRON IRRADIATION

Choochon Lee (Ph.D. Thesis) 1968 194 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-12148

Gold specimens of nominal 99.9999% purity were irradiated with 3 MeV electrons near liquid nitrogen temperature. The damage production rate is found to depend on the purity of the specimen giving a lower value for the high purity specimens. It is also found that the production rate is reduced remarkably by quenching the specimen before irradiation. For high purity gold, a single large annealing peak is observed in Stage III. The slope change method and Primak analysis are employed to obtain the activation energy of Stage III annealing. Both methods give 0.85 ± 0.02 eV for the activation energy in high purity irradiated specimens. The activation energies for quenched, and quench-plus-irradiated specimens of comparable purity are found to be 0.85 ± 0.03 eV and 0.86 ± 0.02 eV respectively, agreeing with the value for the irradiated specimens within the experimental error. Dissert. Abstr.

N69-20089 Pennsylvania State Univ., University Park.

FLOW STRESSES AND MICROSTRUCTURE OF FCC POLYCRYSTALLINE METALS AFTER SHOCK-RELIEF DEFORMATION

Fred Irvin Grace (Ph.D. Thesis) 1967 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-11985

The mechanical strength and microstructure of face centered cubic metals and alloys were investigated after planar shock wave deformation in the pressure range 50 to 400 kilobars. The energy expended on polycrystalline aluminum, copper, and nickel during shock loading was calculated on the basis of an energy analysis of the shock-relief cycle and was used to determine the functional relation between the strength and the applied shock pressure. In the analysis, the MieGrüneisen equation of state and the appropriate Hugoniot compressibility curves were used to determine the thermodynamic parameters associated with the high pressure states in the compressive and relief waves. The results of the calculations show that the amounts of energy expended during shock deformation in a range 50 to 400 kilobars pressure are comparable to that expended during conventional deformation to strains of 10 to 70 percent. Dissert. Abstr.

N69-20104 IIT Research Inst., Chicago, Ill.

IN-PROCESS CONTROL OF RESIDUAL STRESSES IN DRAWN TUBING

Surya Kumar Misra (Ph.D. Thesis) 1968 165 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-13489

Experimental work directed towards the development of means for in-process control of residual stress during tube drawing is described. Experiments were done on 304 and 321 stainless steels, Incoloy 800, and copper tubing. While classical tube reducing processes, such as mandrel and plug drawing and sinking were the main objective, limited data on the effects of rosling and rock-rolling were also included. The distribution of residual axial and hoop

stresses across the wall was determined by Sachs' analysis, wherein resistance strain gages were affixed to the outside surface while the center was progressively dissolved either chemically or electrolytically. Tandem drawing, wherein a small reduction (≈ 2%) was taken in the second die produced a drastic reduction of the residual stress levels. A tapered bearing exit-die was specially efficient in this respect. However, the method was inefficient in pure sinking which always left residual stresses of high magnitude. Dissert. Abstr.

N69-20157 Ohio State Univ., Columbus.
A STUDY OF THE INTERNAL FRICTION OF SOME IRON–MANGANESE AND IRON–MANGANESE–CARBON ALLOYS
Vivekananda Kandarpa (Ph.D. Thesis) 1968 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-12848

Internal friction measurements were made as a function of temperature on some iron–manganese and iron–manganese–carbon alloys to study the stress-induced ordering of carbon in a face-centered cubic lattice. In iron–manganese alloys with manganese content varying from 9 to 15%, a relaxation peak is observed at about 200° C. The location of the peak moved to a higher temperature with an increase in manganese content. Also the peak height increased with an increase in manganese content. The peak is associated with an activation energy of 27 kcal/mole. In iron–manganese–carbon alloys which have a face-centered cubic lattice, a relaxation peak is observed around 280° C. This peak is associated with an activation energy of 37 kcal/mole. The height of the peak is found to vary linearly with atomic concentration of carbon in solution. The broadness of the peak is attributed to the range of activation energies possible for carbon diffusion resulting from the range of ratios of iron to manganese atoms in the vicinity of the interstitial hole. The asymmetry of the peak is attributed to the change in this chemical environment of carbon with temperature. Dissert. Abstr.

N69-20161 Rensselaer Polytechnic Inst., Troy, N. Y.
THE INFLUENCE OF SLIP MODE ON THE BRITTLE FRACTURE OF IRON-49 PERCENT COBALT-2 PERCENT VANADIUM
Kenneth Richard Jordan (Ph.D. Thesis) 1968 151 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-13517

The temperature and grain size dependence of the mechanical properties of ordered and disordered Fe-49%Co-2%V were investigated. The yield and flow stresses obeyed the Petch relationship. Ordering reduced the friction stress, and increased the coefficient of the grain size dependence of the yield stress, at all temperatures investigated. The temperature dependence was found to be greater for ordered material. No correlation was found between the temperature dependence and the ease of cross slip, determined from surface slip band and electron transmission microscopy studies, in either ordered or disordered FeCo–V. Ordered FeCo–V deformed predominantly by |321| slip at low temperatures and |211| slip over a large range of intermediate temperatures. Both planar glide and cross slip were observed above and below the ductile-brittle transition temperature in ordered and disordered FeCo–V. Dissert. Abstr.

N69-20164 Florida Univ., Gainesville.
AN INVESTIGATION OF STRENGTHENING BY G P ZONES IN ALUMINUM–ZINC ALLOYS
Samuel Dacke Harkness (Ph.D. Thesis) 1967 200 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-13008

A strengthening theory based on surface creation has been found to explain quantitatively the critical resolved shear stress increases caused by the zonal state. The theory was also able to qualitatively explain the slip band formation, low work hardening coefficients and wedge shaped fracture found during tensile testing of single crystal Al–Zn specimens at liquid N_2 temperatures. Several other possible strengthening interactions are discussed. An adaptation of the molten zone technique for single crystal growth which utilized focused light was devised. This method allowed 8 cm crystals to be grown in alloys of 25 w/o Zn. A kinetic study was carried out on a series of Al–Zn alloys using this developed ability to construct the size distribution evolution. Actual particle growth paths were plotted for these alloys. A study of the quenched state for a series of Al–Zn alloys was performed. Evidence was found to indicate dislocation loops do not significantly affect the strength of these alloys. Dissert. Abstr.

N69-20195*# Aerojet-General Corp., Azusa, Calif.
A 9Cr–1Mo STEEL AS A MERCURY CONTAINMENT MATERIAL FOR THE SNAP-8 BOILER
B. E. Farwell, D. Yee, and S. Nakazato Jan. 1968 91 p refs
(Contract NAS5-417)
(NASA-CR-72503; AEROJET-3661) Avail: CFSTI CSCL 11F

Various investigations were made to evaluate 9Cr–1Mo steel as a mercury containment material for use in the SNAP-8 boiler. Analysis and experimental data indicate that mercury corrosion of 9Cr–1Mo can be described as a mass transfer process of soluble constituents of the steel into mercury. Mercury corrosion rate is maximum under wetted condition and only such data should be used in evaluating the suitability of the 9Cr–1Mo steel. Author

N69-20204# Ballistic Research Labs., Aberdeen Proving Ground, Md.
MOSSBAUER STUDY OF DILUTE ALLOYS OF IRON
A. Lineberger Nov. 1968 51 p
(AD-680952; BRL-MR-1948) Avail: CFSTI CSCL 11/6

Magnetic ordering in alloys of iron and germanium and iron and tin has been studied by means of the Mossbauer effect. The presence of an impurity in an iron lattice causes a change in the magnetic field at neighboring iron nuclei and therefore changes the hyperfine splitting. Mossbauer absorption spectra in a transmission geometry were used to measure the changes in the hyperfine splitting due to certain numbers and locations of impurities. Assuming the germanium or tin impurities are distributed randomly in the iron lattice and produce localized effects, the spectra of hyperfine splitting were fit to sums of Lorentzian curves. The displacement of a hyperfine splitting spectrum relative to the spectrum for pure iron is proportional to the change in the field. Using nuclear magnetic resonance (NMR) data for the effects of third, fourth and fifth nearest neighbors the field changes due to first and second nearest neighbors were computed. Author (TAB)

N69-20207# Army Materials and Mechanics Research Center, Watertown, Mass.
HIGH ENERGY RATE FORMING (PNEUMATIC-MECHANICAL) OF TYPES 200, 250, AND 300 18% NICKEL MARAGING STEEL
Roger A. Gagne Oct. 1968 23 p refs
(AD-681248; AMMRC-TR-68-19) Avail: CFSTI CSCL 13/8

High energy rate forming with a pneumatic-mechanical press of types 200, 250, and 300 18% nickel maraging steels followed by heat treatment yielded optimum mechanical properties when forged to a 75% reduction at 1900 F. These properties were slightly superior to those observed for the as-received and heat-treated materials. Author (TAB)

N69-20247 Minnesota Univ., Minneapolis.
SOME MECHANICAL PROPERTIES OF ELECTRON BEAM WELDS WHICH HAVE UNCONVENTIONAL GEOMETRIES
Abir Arbel (Ph.D. Thesis) 1968 102 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-12234

The effect of electron beam welds' orientation on the mode of deformation and tensile properties of test specimens was investigated. Electron beam welds of high depth to width ratio were performed on cold rolled stainless steel type 304 at angles of 90, 60, 45 and 30 degrees to the rolling direction. Welded specimens had higher ultimate strengths than annealed specimens although the weld metal had mechanical properties similar to those of the annealed metal. This is in support of the hypothesis that the formation of triaxial tensile stresses in the weld is responsible for high strength of the joint. The ultimate strengths of welded specimens approached that of the cold rolled metal but never reached it. Apparently, it was not the mechanical properties of the weld metal but the high depth to width ratio of the electron beam welds which resulted in the high strengths of the welded specimens. Dissert. Abstr.

N69-20265*# Boeing Co., Seattle, Wash. Aerospace Group.
PLANE-STRAIN CYCLIC FLAW GROWTH 2014-T62 ALUMINUM AND 6AL-4V(ELI) TITANIUM Final Report
L. R. Hall Nov. 1968 169 p refs
(Contract NAS3-7993)
(NASA-CR-72396; D2-114465-1) Avail: CFSTI CSCL 11F

Plane-strain flaw-growth rates were experimentally determined for 2014–T62 aluminum and 6Al–4V(ELI) titanium base metal and weldments. Uniaxially stressed surface flawed specimens were tested in ambient, liquid nitrogen, and liquid hydrogen environments under zero to tension and half tension to tension loading profiles. The experimental approach was based on linear elastic fracture mechanics and included three different methods of determining flaw-growth rates. It was concluded that flaw-growth rates for surface flaws can be expressed in terms of applied stress intensity and used to made reasonable estimates of cyclic life for surface flaws in tension loaded structure. Author

N69-20278# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
CONTRIBUTION TO THE STUDY OF POINT DEFECTS IN URANIUM α [CONTRIBUTION A L'ETUDE DES DEFAUTS PONCTUELS DANS L'URANIUM α]
Jean-Claude Jousset (Ph.D. Thesis–Paris Univ.) Dec. 1968 102 p refs In FRENCH; ENGLISH summary
(CEA-R-3526) Avail: CFSTI

Uranium quenched from temperatures as low as 100°K shows an important increase in resistivity which disappears after annealing between 4.2°K and 41°K. This phenomenon is explained by a cold-work of the metal due to the rapid traversing of the temperature region where the lattice parameters exhibit an important and anisotropic increase. The annealing occurs in two stages (4.2°K - 26°K - 41°K). Purity of samples has an influence on the phenomenon. The model proposed is confirmed by comparison with the annealing of defects created by irradiation of uranium at very low temperatures. Vacancies have been quenched in the metal from temperatures around 650°C (limit of the α phase). The formation energy so found is $E_F = 0.5 \pm 0.15$ eV. The annealing out of the induced resistivity occurs in two stages (300-390°C ; 420-560XC). Author (ESRO)

N69-20296# Royal Aircraft Establishment, Farnborough (England).
A REVIEW OF GLIDE DEFORMATION IN CLOSE PACKED METALS [ZUSAMMENFASSENDE DARSTELLUNG DER GLEITVERFORMUNG IN METALLEN MIT DICHEST GEPACKTER STRUKTUR]
M. Bocek Jul. 1968 71 p refs Transl. into ENGLISH from Physica Status Solidi (Germany), v. 3, no. 12, 1963 p 2189–2214
(RAE-LIB-TRANS-1304) Avail: CFSTI

A comprehensive review of the data for single crystal stress-strain curves of fcc and hcp metals is presented. Dislocation models proposed for the various stages are summarized and the relevant parameters are tabulated. Extensive experimental evidence is available for fcc metals, but there is a lack of data for hcp metals with $c/a < \sqrt{3}$. Author

N69-20331 IIT Research Inst., Chicago, Ill.
EMBRITTLEMENT OF LEADED STEEL AT INTERMEDIATE TEMPERATURES
Sheldon Mostovoy (Ph.D. Thesis) 1968 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-13488

A detailed investigation was made of the influence of 0.30 per cent lead on the room and elevated temperature mechanical properties of a 4145 steel. Leaded and non-leaded versions of this identical steel were quenched and tempered to room temperature strength levels ranging from 120 to 240 KSI. The properties measured included both complete tensile data and impact energies for all strength levels. Macrofractographs detailing differences in fracture morphology at specific test temperatures were also included. A comparison of tensile ductility between the non-leaded and leaded steel showed small differences in reduction of area below 400 or above 900° F. However, between 400 and 620° F, the melting point of lead, RA decreased rapidly at all strength levels. Maximum embrittlement occurred at or somewhat above 621° F and its severity was directly related to strength level. Dissert. Abstr.

N69-20333 Delaware Univ., Newark.
THE ELECTRONIC WORK FUNCTIONS OF COPPER–GOLD ALLOYS
Sheldon Jacob Cytron (Ph.D. Thesis) 1967 111 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-13163

The applicability of employing a retarding field characteristic displacement method to determine the relative electronic work functions of copper–gold alloys has been demonstrated. By this method the thermionic emission from a tantalum filament in a multi-anode diode assembly was analyzed to determine the relative work functions of the anodes. The anodes were alloy rings prepared under an atmosphere of argon by induction melting and chill casting. The anodes were outgassed by electron bombardment prior to obtaining the emission data. The measurements were obtained in vacuo at approximately 10^{-8} torr. The filament was pulse heated to thermoemission temperatures and the emission current measured during the non-heating portion of the pulse cycle. The results for two copper–gold alloys show them to have higher work functions than the work functions of the pure components. Dissert. Abstr.

N69-20338# Franklin Inst., Philadelphia, Pa.
THE MAGNETIC PROPERTIES OF BINARY ALLOYS OF NON-EQUILIBRIUM STRUCTURE Final Report, 10 Jun. 1965–6 Oct. 1968
John D. Blades Nov. 1968 44 p refs
(Contract DA-31-124-ARO(D)-367)
(AD 681290; F-B2361; AROD-5492.2-MC) Avail: CFSTI CSCL 11/6

A study of the magnetic properties of three binary alloy systems in the thin layered state was performed: Cu-Mn, Al-Mn and Er-Co. The films prepared by a fast quenching co-vapor

deposition diffraction and transmission, and electron spin resonance measurements. The Cu-Mn system has been found to be a soluable face-centered cubic system and is magnetic at CuMn. The Al-Mn system was found to be insoluable by the utilized fabrication process except for the high temperature phase at 50 weight percent Mn and was found to be nonmagnetic. At 16 weight percent Er-Co no metastable homogeneous crystallographic system was found, and the magnetic properties are those characteristic of Co. All films prepared indicated a trend towards the amorphous state, especially for binary systems with atomic diameter ratios of 10% or greater. Systems with atomic diameter ratios less than 10% appear to attain metastable crystal systems. Oxygen has been detected in the films prepared, but its role is not clear. The rapidly quenched thin layered system has significantly different physical properties from those of the bulk state where this has been possible to evaluate.
Author (TAB)

N69-20378# Naval Research Lab., Washington, D. C.
PROCEDURES FOR FRACTURE TOUGHNESS CHARACTERIZATION AND INTERPRETATIONS TO FAILURE-SAFE DESIGN FOR STRUCTURAL TITANIUM ALLOYS Interim Report
R. J. Goode, R. W. Judy, and R. W. Huber, Jr. Dec. 1968 29 p refs
(AD-681043; NRL-6779) Avail: CFSTI CSCL 11/6

Interpretations of fracture toughness characteristics, as measured by various test procedures, for solutions of general engineering problems are presented for structural titanium alloys. Analytical procedures evolved from fracture mechanics theory are used for quantitative interpretations of engineering fracture toughness tests. The procedural simplicity of the engineering tests coupled with the analytical capabilities of fracture mechanics theory provides for a significant advancement in failure-safe design procedures for titanium alloys covering the full range of strength levels.
Author (TAB)

N69-20395# National Bureau of Standards, Washington, D. C. Metallurgy Div.
MOESSBAUER EFFECT STUDY OF MAGNETIC ORDERING IN COPPER-RICH Cu–Ni–Fe ALLOYS
L. J. Swartzendruber Aug. 1968 140 p refs
(NBS-TN-463) Avail: SOD $1.25

The ^{57}Fe Mössbauer effect has been observed in a series of copper rich Cu–Ni–Fe alloys, and for two samples of gold rich Au–Fe. At low temperatures most of these alloys order magnetically, and the Mössbauer effect spectra develop typical six-line hyperfine field structure. For dissolved Fe the room temperature Cu–Fe and Au–Fe spectra consist of a doublet superimposed on a central line. In Cu–Ni–Fe the spectra at room temperature consist of a doublet with no evidence of a central line when the Ni concentration is above 10 atomic percent. The doublet separations at room temperature (and their estimated uncertainties) are 0.69 ± 0.02, 0.58 ± 0.02 and 0.22 ± 0.04 mm/sec in Au–Fe, Cu–Fe and Cu–Ni–Fe respectively. By observation of the spectra in a magnetic field, the doublet structure is shown to be due to magnetic interactions between Fe and other Fe or Ni atoms. Isomer shifts, metallurgy in Cu–Ni–Fe alloys, sample preparation techniques, and the Mössbauer effect equipment developed are also discussed.
Author

N69-20403# Naval Research Lab., Washington, D. C.
FATIGUE CRACK PROPAGATION IN A HIGH-STRENGTH STEEL UNDER CONSTANT CYCLIC LOAD WITH VARIABLE MEAN LOADS Final Report
T. W. Crooker and E. A. Lange Nov. 1968 22 p refs
(AD-681026; NRL-6805) Avail: CFSTI CSCL 11/6

Fatigue crack propagation studies were conducted on a 9Ni-4Co-0.25C high-strength steel using a constant cyclic load and variable mean loads. The load ratio, R, was varied from +0.5 to -1.0. Fatigue crack growth rates were analyzed using the crack tip stress-intensity factor, K. The results show that mean loads exert a strong secondary influence on fatigue crack propagation. Data were fitted to two crack propagation equations which seek to account for mean loads. Both equations significantly reduced, but did not eliminate, the layered scatter caused by mean loads.
Author (TAB)

N69-20404# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THE DEFORMATION OF PLASTICALLY NON-HOMOGENEOUS MATERIALS Final Technical Report
M. F. Ashby Dec. 1968 78 p refs
(Contract N00014-67-A-0298)
(AD-681041; TR-579) Avail: CFSTI CSCL 11/6

Many two-phase alloys work harden much faster than do pure single crystals. Such alloys are plastically non-homogeneous, because gradients of plastic deformation are imposed by the microstructure; dislocations are stored in them to accommodate the deformation gradients, and so allow compatible deformation of the two phases. With the exception of single-phase single crystals, almost all metals and alloys are plastically non-homogeneous. The results of this research indicate that more attention should be given to the non-uniform aspects of plastic deformation, and that a plasticity theory based on dislocation mechanics can be constructed for certain such alloys.
TAB

N69-20417# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL CHANGES DURING THE OXIDATION OF CHROMIUM YTTRIUM ALLOYS
L. M. Kumok, L. N. Larikov, T. K. Yatsenko, and E. A. Maksimenko Jan. 1968 9 p refs Transl. into ENGLISH from the Russian
(AD-680774; FTD-HT-23-1259-67) Avail: CFSTI CSCL 11/6

The oxidation behavior at 1100--1450C of 99.9%-pure chromium and chromium-yttrium alloys containing 0.5, 1.0 or 2.0% yttrium was studied. It was found that yttrium improves the oxidation resistance of chromium and the oxidation rate of all the alloys tested, especially that of the alloy containing 0.5% yttrium, was much lower than that of pure chromium. On all the alloys tested, a dense tightly adhering oxide layer was formed, while the oxide layer on pure chromium easily pealed off. In pure chromium, a certain quantity of chromium oxides and nitrides was formed to a depth of 650 microns in a metal oxidized at 1450C for 9 hr. In chromium-yttrium alloys, the amount of chromium oxides was much smaller and the nitrides were absent altogether. The penetration of oxygen and nitrogen into pure chromium proceeds mostly along the grain boundaries. This was not observed in the chromium-yttrium alloys. It is believed that yttrium improves the oxidation resistance of chromium primarily by a refining effect.
TAB

N69-20424# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
STUDY OF THE POINT DEFECTS FORMED IN COBALT BY ELECTRON BOMBARDMENT [ETUDE DES DEFAUTS PONCTUELS CREES PAR BOMBARDEMENT ELECTRONIQUE DANS LE COBALT]
Gaston Sulpice (Ph.D. Thesis) Dec. 1968 56 p refs In FRENCH; ENGLISH summary
(CEA-R-3604) Avail: CFSTI

A study of the point defects formed in cobalt by electron bombardment is presented. The results are compared with those previously obtained for two other ferromagnetic metals of different structure, iron and nickel. In the first part a review of the literature concerning the creation of point defects, their contribution to the resistivity and their annihilation mode in the three structure types is given and the experimental techniques adopted, in particular the study of the resistivity increase during a linear temperature rise are discussed. The investigations concern the following essential points: the observation of the successive annihilation stages of the point defects formed in pure cobalt, a study of the variations with respect to the doses and energy of the incident particles, and the determination of the annealing kinetics and the corresponding activation energies. The results are finally compared with the various models of point defect annihilation proposed for other metals none of which are in perfect agreement with the results. In the case of cobalt one must modify the model proposed by the laboratory for iron and nickel. The difference between these three metals is explained by the anisotropic character of the cobalt matrix. Author (ESRO)

N69-20498# Brown Univ., Providence, R. I.
NOTCH BRITTLENESS AFTER PRESTRAINING Final Report
C. Mylonas and S. Kobayashi Jan. 1969 49 p refs
(Contract NObs-88294)
(AD-681051; SSC-192; TR-7) Avail: CFSTI CSCL 13/13

Notched plates and bars prestrained in compression or extension, before or after notching, at 70F or 550F were tested to fracture in tension at -16F. It was found that a catastrophic reduction of ductility could be caused by small prestrains. Uniform longitudinal or transverse prestraining by as little as 0.05 at 70F reduced the initial ductility of notched bars by a factor of 4 or more. Hot prestraining was even more damaging: the greatest drop in the ductility at -16F was caused by prestrains of only 0.025 at 550F. These tests indicate that the brittle behavior of mild steel structures results from some damaging prior history of straining. Accordingly the proper selection of steels should be based on their resistance to embrittlement by suitable straining rather than on their properties in the initial undamaged state. The presented testing methods offer a great control over the steel ductility. They would be useful both in steel assessment and in the investigations of the factors influencing the resistance of steel to fracture. Author (TAB)

N69-20532# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL CONDUCTIVITY OF GERMANIUM STRONGLY ALLOYED WITH ARSENIC AND GALLIUM
D. G. Arasly, M. Aliev, and V. I. Fistul Apr. 1968 14 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Mat. i Tekhn. Nauk (Baku), no. 5, 1965 p 103–109
(AD-680925; FTD-HT-23-726-67) Avail: CFSTI CSCL 20/12

A study was made of the effect of alloying germanium with donor and acceptor impurities in a wide range of concentrations with an aim at ascertaining the influence of the degree of doping. The impurity concentrations ranged from 1.4 x 10 to the 14th power to 10 to the 20th power/cu cm and the tests were made in the temperature range 100-500K. The samples were single crystals grown by the Czochralski method under conditions ensuring homogeneity of the samples, and cut in the form of parallelepipeds measuring 4 x 5 x 12 mm. The thermal conductivity was measured by a stationary method in a vacuum of the order of 0.001 mm Hg. Tests at 300K have shown that, up to 10 to the 17th power/cu cm, the thermal conductivity of germanium depends neither on the amount or the type of the doping impurity, exhibiting a plateau at a value 0.60 W/cm-deg. A higher concentrations, the thermal conductivity drops to 0.471 W/cm-deg for an arsenic content 5.45 x 10 to the 19th power/cu cm, and to 0.53 W/cm-deg for germanium containing 1 x 10 to the 20th power/cu cm of gallium. The temperature dependence of the strongly doped germanium is linear, whereas in the case of weak doping the growth of thermal resistance begins to exhibit a decrease. In purer samples k approximately T to the minus 0.23 power at T > 300K and k approximately T to the minus 1.15 power < 300K. The fact that the thermal conductivity is proportional to the reciprocal of the temperature offers evidence of the dominating role of three-phonon processes. Deviations from this proportionality is attributed to the appearance of photon thermal conductivity. TAB

N69-20538# Pennsylvania State Univ., University Park. Dept. of Materials Science.
RECRYSTALLIZATION IN THORIA DISPERSED NICKEL SHEET Scientific Interim Report
Maurice C. Inman Oct. 1968 27 p refs
(Grant AF-AFOSR-669-67-19)
(AD-681191; AFOSR-68-1993) Avail: CFSTI CSCL 11/6

Recrystallization in thoria dispersed nickel sheet was examined as a function of strain-anneal cycles employing various degrees of cold deformation followed by heat treatment at temperatures in the range 500C to 1300C. Electron transmission techniques were used for quantitative determination of the degree of recrystallization. As might be expected, the observed percentage of recrystallized material after any chosen heat treatment regime progressively increased with increasing severity of prior cold deformation in a single cycle of strain and anneal. However, the material exhibited a remarkable resistance to complete recrystallization. The most severe strain-anneal cycle employed, (80 percent cold reduction plus one hour at 1300C), could not promote more than 80 percent recrystallization. Recrystallization resistance also appeared to be fortified by successive cycles of strain and anneal. Substructure examination clearly showed the presence of a banded structure where the alternate bands of recrystallized and unrecrystallized material were aligned along the original cold rolling direction. The substructure offered no immediate explanation of the resistance to recrystallization in specific regions of the material, although it is worth noting that particle-matrix interface cavities previously proposed as grain boundary pinning points were not observed. Electron diffraction scanning of transmission specimens indicated strong grain alignment in localized regions (texture), but a positive correlation with recrystallization resistance has not yet been found. Author (TAB)

N69-20541# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
PRECIPITATE-FREE ZONES AND STRESS-CORROSION CRACKING IN A TERNARY AL–ZN–MG ALLOY
A. J. Sedriks, P. W. Slattery, and E. N. Pugh Jan. 1969 25 p refs
(Contract N00014-67-C-0496)
(AD-681052; RIAS-TR-69-1C) Avail: CFSTI CSCL 11/6

A study was made of the role of the precipitate-free zone (PFZ) in the stress-corrosion cracking of a ternary Al-5.3 w/o Zn-2.5 w/o Mg alloy in aqueous chloride solutions. For alloys heat treated to give the same hardness (140 D.P.N.), susceptibility was found to depend on the width of the PFZ (in the range 0.04-0.35 microns), both the time to initiate and to propagate stress-corrosion cracks decreasing significantly with decreasing PFZ width. Application of small anodic currents (e.g. 0.2 mA/sq cm) reduced failure times by about two orders of magnitude, while cathodic currents inhibited failure. Fractographic studies indicated that the mode of stress-corrosion failure differs from that obtained in normal tensile fracture; no evidence for discontinuous crack propagation was found. These and other observations are discussed in terms

of the proposed mechanisms of stress-corrosion cracking, and shown to be consistent with a mechanism involving localized anodic dissolution of plastically deforming solid solution within the PFZ. Author (TAB)

N69-20561# Ministry of Technology, Orpington (England).
EVALUATION OF HARD ANODISING AS A WEAR RESISTANT COATING FOR ALUMINUM ALLOYS WITH PARTICULAR REFERENCE TO ITS USE AS A SUBSTRATE FOR SOLID PHASE LUBRICANTS
D. Keyworth Jun. 1968 136 p
(AD-680852; S/T-MEMO-6-68) Avail: CFSTI CSCL 11/3

The report describes investigations of: Comperison of major types of hard anodic film; examination of abrasion resistance; wear resistance with various surface treatments, with or without solid phase lubricant; measurement of coefficient of friction when suitable lubricants are added; measurement of bearing properties on films of various thicknesses; effect on fatigue properties of shot-peening, surface finishing prior to anodising and various sealing treatments after anodising; corrosion resistance when film is sealed with various solid phase lubricants and in contact with various materials. Author (TAB)

N69-20588# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HEAT TREATMENT OF ALUMINUM ALLOYS, TABLE 4 AND CHAPTERS 12 AND 13
I. F. Kolobnev 29 Mar. 1968 37 p refs Transl. into ENGLISH from Term. Obrabotka Alyumin. Splavov (Moscow), 1966 p 62–63, 243–273
(AD-680927; FTD-HT-23-1627-67) Avail: CFSTI CSCL 13/8

The report deals with heat treatment of aluminum alloys. Heat treatment as applied to cast aluminum alloys or aluminum alloys containing silicon, magnesium, manganese, beryllium, titanium, and other components. Heat treatment of forging and wrought alloys are discussed. Characteristics of commercial heat-treatment regimes for aluminum casting alloys are tabulated. Author (TAB)

N69-20589# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WAYS OF PERFECTING THE TECHNOLOGY OF MAKING LARGE CASTINGS
L. V. Prozorov 5 Jun. 1968 13 p Transl. into ENGLISH from Kuznechno-Shtampovochnoye Proizv (USSR), v. 9, no. 1, 1967 p 1–3
(AD-681263; FTD-HT-23-21-68) Avail: CFSTI CSCL 13/8

A discussion is given of the progress made in non-Soviet countries in working refractory alloys and other metals with relatively low ductility, and considers the problems which must be solved for increasing Soviet production of large forgings. It is pointed out that forging productivity can be increased only by automation, mechanization and development of new technological processes for producing blanks. Scientific research and design organizations in the Soviet Union today are devoting their main efforts to development of programmed control systems applicable to traditional forging methods. It is felt that more energy should be devoted to development of progressive technology which fits into the requirements of complex mechanization and automation. Some of the steps to be taken in achieving this goal are discussed and recommendations are made for improving the workability of refractory metals by mechanical heat treatment. Improvements in ingot production are suggested. It is pointed out that the production of forging blanks by the most progressive methods will require high-speed hydraulic presses with a capacity of 20-30 thousand tons. Author (TAB)

N69-20613# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
CONTRIBUTION TO THE STUDY OF THE ELECTRODEPOSITION OF IRON-NICKEL ALLOYS [CONTRIBUTION A L'ETUDE DU DEPOT ELECTROLYTIQUE DES ALLIAGES FER-NICKEL]
Jean Valignat (Ph.D. Thesis—Grenoble Univ.) 1968 58 p refs In FRENCH; ENGLISH summary
(CEA-R-3454) Avail: CFSTI

Using a coulometric technique based upon the anodic intensiostatic dissolution, the potentiostatic deposition of nickel, iron and nickel iron alloys has been studied. It is shown that the minimum of the curve I = f (t) (deposition current versus time) is probably due to the transitory blocking of the surface by hydrogen and that the syncrystallisation of nickel and iron is responsible for the anomalous codeposition of these two elements. Author (ESRO)

N69-20628# Air Force Cambridge Research Labs., Bedford, Mass.
AN AUTOMATIC ELECTRIC ANNEALING FURNACE
Joseph A. Adamski and W. Arnold Yasinski Oct. 1968 19 p refs *Its* Instrumentation Paper No. 150
(AD-680777; AFCRL-68-0528) Avail: CFSTI CSCL 13/1

A novel technique for annealing corundum crystals consists in rapidly cooling the crystals to room temperature after growth is complete, transferring them to an automatically programmed electric furnace and reheating them to 1980 deg. C, and then cooling them at the same rate as they were brought up to the annealing temperature. The total cycle is 32 hr. Results are consistently reproducible. Author (TAB)

N69-20643# Washington Univ., Seattle. Coll. of Engineering.
THE MICROSTRUCTURAL ASPECTS OF DEFORMATION AND FRACTURE AT ELEVATED TEMPERATURES Final Report, 1 Jun. 1964–31 Dec. 1968
R. Taggart and D. H. Polonis 17 Dec. 1968 14 p
(Contract Nonr-477(40))
(AD-681359) Avail: CFSTI CSCL 11/6

A deformation hot stage metallographic facility was designed, constructed and operated successfully during the investigation of several specific problem areas. The topics that were studied include vacancy condensation pit formation on aluminum surfaces, crack propagation in aluminum polycrystals and the strain induced transformation of metastable alloy phases. Some selected experiments were conducted to study the effects of temperature and pressure on the embrittlement of aluminum and zinc by liquid metals. Author (TAB)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N69-19802*# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
APOLLO GAS-BEARING MATERIALS PROGRAM Final Report
Henry H. Rowe, Jr. Oct. 1968 98 p refs
(Contract NAS9-4576)
(NASA-CR-99539; R-624) Avail: CFSTI

This report describes the results of a program to develop and evaluate an improved aluminum oxide ceramic gas-bearing

material. The material for evaluation consisted of a fine-grain size, hot-pressed aluminum oxide, with and without a vapor-deposited coating of the same material. Evaluation included extended start-stop testing as well as slew testing to touchdown. Both material combinations exhibited superior wear characteristics to the conventional materials previously tested, but failed to provide a high-speed touchdown survivability for the design evaluated. Author

N69-19804*# Southern Research Inst., Birmingham, Ala.
THE DEVELOPMENT OF A LIGHTWEIGHT COATED LIFE RAFT FABRIC WITH IMPROVED ABRASION RESISTANCE Final Report
15 Oct. 1968 68 p refs
(Contract NAS9-4189)
(NASA-CR-99538; Rept-39) Avail: CFSTI CSCL 11E

A process was developed for the continuous production of polypropylene filaments with tenacities of 13 grams per denier for weaving into fabric for the preparation of a coated liferaft fabric. The process for producing high-tenacity filaments consists of melt spinning the filaments under conditions that permit only slight crystallization to occur in the filaments and then producing a high degree of orientation of the polymer chains in the filaments in a two-stage continuous drawing operation. Further work on the polypropylene fabric was halted because neither the polypropylene fabric nor the coating that was to be applied to make a liferaft fabric was fireproof. Polyurethane coatings were specified for use on the liferaft fabrics. Investigation of this class of coating materials led to the conclusion that soluble gums would be the most desirable for use on the liferaft fabric. Author

N69-19623*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY OF THE POTENTIAL BENEFITS OF USING LOWER-DENSITY ABLATORS FOR PROTECTING MANNED LIFTING-BODY ENTRY VEHICLES
James N. Moss (M.S. Thesis-Va. Univ.) Jun. 1968 108 p refs
(NASA-TM-X-61466) Avail: CFSTI CSCL 11B

Results are presented of an experimental investigation of low-density (10- to 20-lb/ft^3) phenolic-nylon ablative materials and of an analysis of the ablative heat shield weight requirements of a 13° blunted half-cone entry vehicle for various entry attitudes (lift). The ablative effectiveness of some of the low-density materials was found to be about 1.5 times that of a 36-lb/ft^3 phenolic-nylon ablator. Furthermore, it was found that a 14-lb/ft^3 ablator provided high ablative effectiveness while maintaining good structural char integrity when exposed to a range of test conditions that was inclusive of most of the environmental conditions experienced by a manned lifting-body entry vehicle. Analysis shows that the ablative heat-shield weight requirements are strongly dependent on the entry attitude, decreasing with increasing lift; and that a 34 per cent reduction in the total weight of the ablative heat shield may be obtained by using a 14-lb/ft^3 rather than a 36-lb/ft^3 phenolic-nylon ablator. Author

N69-19825*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MECHANICAL BEHAVIOR OF BORON-EPOXY AND GLASS-EPOXY FILAMENT-WOUND CYLINDERS UNDER VARIOUS LOADS
Harvey W. Herring, Robert M. Baucom, and Richard A. Pride Washington Mar. 1969 66 p refs
(NASA-TN-D-5050) Avail: CFSTI CSCL 11D

A study was made to determine the mechanical behavior of boron-epoxy and S-glass-epoxy filament-wound cylinders under tensile, compressive, torsional, and pressure loads. These cylinders were fabricted in either an orthotropic winding pattern or an isotropic pattern. Conventional theory used to predict the elastic behavior of glass-epoxy filament-wound cylinders was discovered to be equally adequate for the boron-epoxy cylinders. Since Young's modulus for a boron filament is much greater than that for a glass filament, the boron-epoxy cylinders were considerably stiffer than those of glass-epoxy. Attempts to correlate cylinder failure strengths calculated from existing state-of-the-art theories with experimental failure strengths met with varying success. Thus, additional research is necessary before failure characteristics of filament-wound composite cylinders, either glass- or boron-reinforced, can be accurately predicted. Author

N69-19918*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TENSILE BEHAVIOR OF BORON FILAMENT REINFORCED EPOXY RINGS AND BELTS
Robert M. Baucom Washington Mar. 1969 31 p refs
(NASA-TN-D-5053) Avail: CFSTI CSCL 11D

The room-temperature tensile characteristics of boron-filament epoxy-resin composites have been determined. The effect of low to elevated temperatures on rings and cyclic loading on belts was also investigated. An analysis of the tensile strength of the monofilaments used for the fabrication of the composite specimens is included. In addition, a theoretical analysis of the bending stresses inherent in ring tensile testing is presented. The average strength of the boron monofilaments before winding into the rings and belts was about 406 ksi (2800 MN/m^2). The average room temperature strength of the composites ranged from 90 ksi (620 MN/m^2) for the rings to 66 ksi (455 MN/m^2) for the belts. These low composite strengths are the result of two principal factors: low filament-volume fraction in the composite, and bending stresses induced by the ring test fixtures. With these two factors considered, the filament strength in the composite ring was 85% of the average monofilament strength. Author

N69-19940*# Philco-Ford Corp., Blue Bell, Pa. Microelectronics Div.
DEVELOPMENT OF GLASS PASSIVATION METHOD FOR SEMICONDUCTOR DEVICES FOR SATURN SYSTEM Final Report, 28 Jun. 1966–16 Aug. 1968
Aug. 1968 298 p refs
(Contract NAS8-18048)
(NASA-CR-98358; R-518) Avail: CFSTI CSCL 11B

A technique for providing additional encapsulation for semiconductor elements has been developed. In this technique, a glass coating is formed over the surface of an oxide-passivated semiconductor chip by reacting silane with oxygen. This coating provides an additional protective sheath for the semiconductor chip. The benefits which accrue from such a coating are as follows: (1) redundant environmental protection, (2) higher manufacturing yield, (3) better reliability, (4) multilayer metalization, (5) reduced surface channeling, and (6) reduced parasitic capacitance. Author

N69-19944 Wisconsin Univ., Madison.
THERMAL RESPONSE OF A CONCRETE SLAB TO CONTROLLED DAYTIME AND NIGHTTIME CYCLES OF RADIATION
John Colin Turner (Ph.D. Thesis) 1968 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-9142

A micrometeorological investigation was made of the energy partitioning at, and the temperature of, a concrete surface in response to induced short-period cycles of radiation incident on that surface. The idea of inducing artificial radiation cycling by directing a grid of heat lamps at the surface under consideration was

studied. By appropriately varying the lamp voltages, it was found that step functions of radiation could be obtained which closely resembled simple sinusoidal curves. A concrete surface (measuring 75 feet by 50 feet) was used because it offered valuable simplifications; uniform thermal properties and a uniform, smooth, non-evaporating surface. Short periods of radiation (of the order of minutes to tens of minutes) were employed because at such frequencies relatively more of the radiation is partitioned towards heating the ground, and thus one or both models might be better used to estimate an important thermal parameter of the ground, its thermal admittance.

N69-20004# Gulf General Atomic, San Diego, Calif.
STRUCTURE AND PROPERTIES OF PYROLYTIC CARBON
J. C. Bokros 6 Sep. 1968 36 p refs
(Contract AT(04-3)-167)
(GA-8888) Avail: CFSTI

The dependence of both the thermal expansion of pyrolytic carbon and the neutron irradiation-induced dimensional changes on the structure of pyrolytic carbon is discussed. Possible explanations for these dependences are explored. New applications of high-strength carbons deposited in fluidized beds are reported including a prosthetic cardiac valve. NSA

N69-20020 Pennsylvania State Univ., University Park.
NEW EXPERIMENTAL AND THEORETICAL APPROACHES TO THE GLASSY STATE
Peter Thomson Sarjeant (Ph.D. Thesis) 1967 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-12005

Metastable unary and binary oxide phases obtained by rapid quenching techniques have been investigated by infrared spectroscopy, X-ray and the electron probe. The rate of cooling required to form SROO solids has been found to depend directly on the melting temperature and coefficient of self diffusion, and inversely upon melt viscosity, relaxation time and linear dimensions of the ionic species comprising the melt. Calculated dependence of the formation of SROO solid phases as a function of these parameters is shown graphically. The relation of crystal chemical parameters (such as ionic radius, coordination and valence) is shown to be critical in glasses formed by rapid quenching of perovskite and garnet compositions. Single oxides with oxygen ions in close packed array or in coordination three or higher could not be rapidly quenched to glasses. A wider compositional range for metastable crystalline solid solution was found in certain binary systems. The relation between the structure of the melt and these metastable phases is discussed. Dissert. Abstr.

N69-20234# Picatinny Arsenal, Dover N. J. Materials Engineering Lab.
SURFACE TREATMENT OF POLYMERS WITH ACTIVATED GAS PLASMA FOR ADHESIVE BONDING
J. Richard Hall, Carolyn A. L. Westerdahl, Andrew Devine, and Michael J. Bodnar Jan. 1969 32 p refs
(AD-680957; TR-3788) Avail: CFSTI CSCL 13/8

Several thermoplastic polymers were treated with activated helium and with activated oxygen. Bond strengths of adhesive-bonded specimens prepared from treated and from untreated coupons were compared. Treatment with activated gas plasma prior to bonding significantly increased the adhesive joint strength of many polymers, even with exposure times of as short as one-half minute. Author (TAB)

N69-20253# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMBINED MATERIALS IN ROCKET TECHNOLOGY
24 Apr. 1968 24 p refs Transl. into ENGLISH from Vop. Raketnoi Tekhn. (USSR), v. 16, no. 2, 1966 p 34–45
(AD-680947; FTD-MT-24-96-68) Avail: CFSTI CSCL 11/4

The authors consider materials used in the making of the power shells of motors, the nozzle block, and the thermal shielding skin. The process of winding glass in the form of fibers is noted as the most promising method of making the motor shell. A table is given of the specific strength of various constructional materials, including vitreous plastic based on E and S state fibers and combinations of epoxy resins with metal wires. The possibility of increasing strength, rigidity, and heat resistance of the wound structures is pointed out, by means of a modification of the state of the wire, the use of hollow wire, and boron wire. Graphs are given illustrating growth in the specific strength of certain materials up to 1972, the change in the characteristics of vitreous plastics when solid wire is replaced by hollow, and the dependence of the strength of the wires on the temperature. Laminated materials suitable for high temperature use are described. Author (TAB)

N69-20342# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE QUESTION OF IMPROVING SOME POLYVINYL CHLORIDE POLYMERS AND A METHOD OF IMPROVING THEIR TOXICITY
G. M. Gorban et al Apr. 1968 13 p refs Transl. into ENGLISH from Kosmich. Biol. Med. (USSR), v. 1, no. 2, 1967 p 47–51
(AD-680924; FTD-HT-23-1464-67) Avail: CFSTI CSCL 11/9

A method is developed for improving the polyvinyl chloride tapes for the purpose of decreasing their gas emanation. The overall gas emission of organic substances from the improved specimens of polyvinyl chloride tapes as a result of the treatment with 50% urea solution is reduced by a factor of 2 1/2. The improved polyvinyl chloride tapes give off volatile chemical substances in small concentrations, which with long duration of their action on the organism cause only a weak biological effect. As a result of the treatment with a solution of urea there is an improvement in the electrical insulation properties of the polyvinyl chloride tapes serving the purpose for which the materials are intended without change in their strength characteristics. Author (TAB)

N69-20492# Purdue Univ., Lafayette, Ind.
VISCOELASTIC BEHAVIOR OF FIBER-REINFORCED COMPOSITE MATERIALS Final Report, 1 Feb.–31 Dec. 1967
Y. C. Lou and R. A. Schapery Apr. 1968 50 p refs
(Contract F33615-67-C-1412)
(AD-681136; AFML-TR-68-90) Avail: CFSTI CSCL 11/4

Tensile creep and recovery response of unidirectional, glass fiber-epoxy specimens is studied. In the series of tests reported herein, all loading is normal to the fiber axis. The glass transition temperature, Tg, for the epoxy is determined from thermal expansion measurements normal to the fibers, and the temperature at which the material starts to appreciably soften is found by measuring creep in the presence of a slowly increasing temperature. Linearity of creep and recovery behavior is then studied at room temperature and near Tg. The material at room temperature is found to be approximately linearly viscoelastic out to fracture, but considerable nonlinearity in the form of nonrecoverable deformation appears at temperatures in the neighborhood of Tg. In a concluding analytical study the influence of initial transients in creep and relaxation tests is estimated. This information provides a useful guideline for reducing creep and relaxation test data. Author (TAB)

N69-20506# RAND Corp., Santa Monica, Calif.
THE INFLUENCE OF RANDOM FILAMENT PACKING ON THE ELASTIC PROPERTIES OF COMPOSITE MATERIALS
Donald F. Adams and Stephen W. Tsai Dec. 1968 48 p refs
(Contract F-14620-67-C-0045)
(AD-680758; RM-5608-PR) Avail: CFSTI CSCL 11/4

A new method of micromechanical analysis of composite materials (such as boron- or glass-fiber-reinforced aluminum or epoxy) that takes account of the randomness of arrangement of the reinforcing filaments. Previous analyses assumed a regular geometric array, in which case a physically unrealistic square array showed surprising agreement with experimental data. Since available computers cannot handle a completely random arrangement, a basic pattern was generated by random-number techniques and was then reflected to obtain symmetry; this unit was assumed to repeat itself throughout the material. Solutions for the modulus of elasticity were obtained for a 10-by-10 random array, for each of 20 random geometries using constituent stiffness ratios corresponding to boron/aluminum, glass/epoxy, and boron/epoxy composites, for filament volume contents of 39, 55, and 70 percent. The assumed symmetry permitted the use of standard boundary/value solution methods. When the assumed filament packing array is randomized, the more physically realistic hexagonal random array is in better agreement with the data than the square random array. Since the latter results in much higher local stress concentrations, use of the square array model could lead to unduly conservative analyses.
Author (TAB)

N69-20664# American Optical Co., Southbridge, Mass. Central Research Lab.
RESEARCH AND DEVELOPMENT OF HIGH QUALITY LASER GLASS Semiannual Technical Report for Period Ending 30 Jun. 1968
Richard F. Woodcock and Carl G. Silverberg Jan. 1968 32 p
(Contract N00014-68-C-0192; ARPA Order-306; Proj. Defender)
(AD-681362; SATR-1-TR-607-1) Avail: CFSTI CSCL 11/2

The use of Nd doped glass systems for high brightness or high intensity applications requires that the laser material must be free of metallic inclusions, of good optical quality, free of Fe(2+) ion impurities which absorb strongly at 1.06 micrometers and in many cases must possess these properties over large volumes of glass. This report describes progress over a six month period toward achieving this end. Two all-ceramic melting facilities are described and operational problems are delineated. Model homogenization experiments were performed and results are presented. Evaluation of glass produced from the all-ceramic facilities was carried out and the data are tabulated. Finally, conclusions drawn from these studies and a description of work for the next six month period are included.
Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N69-19643*# Clemson Coll., S. C. Dept. of Mathematics.
STATISTICAL FILTER THEORY APPLIED TO A MODEL WITH APPROXIMATE TRANSITION MATRICES, PART 2
Dec. 1967 26 p refs
(Contract NAS8-11259)
(NASA-CR-100330) Avail: CFSTI CSCL 12A

An investigation of an application for the statistical filter theory is presented. R. E. Kalman's statistical filter was applied to a nonlinear mathematical model. A simulation model was constructed so that two linearization techniques; first, linearization by neglecting the nonlinear terms and second, linearization at each time step could be investigated.
Author

N69-19680# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
BASIS OF THE THEORY OF TWO-PLAYER QUALITATIVE GAMES. PART 2: THE SINGLE-TARGET GAME [BASES DE LA THEORIE DES JEUX QUALITATIFS A DEUX JOUERS. DEUXIEME PARTIE: JEUX A UNE SEULE CIBLE]
Francoise Gerard (Paris Univ.) Apr. 1968 90 p refs In FRENCH; ENGLISH summary
(CEA-R-3475-PT-2) Avail: CFSTI

As in the first report games of kind are studied and players J^P and J^E can influence the motion of the state of the game by choosing strategies in given sets. In this report single-target games are considered in which the strategies are piecewise continuous functions of time. The map of the game is defined in the same way and some topological properties of the sets of this map and the properties of boundary paths are discussed. A minimax theorem of such paths is derived. Quasi-autonomous games are studied and illustrated by examples and a connection appears between the theory of qualitative games and the theory of stability.
Author (ESRO)

N69-19685# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
CONVERGENCE OF SOME RELAXATION METHODS IN CONVEX PROGRAMMING [CONVERGENCE DE CERTAINES METHODES DE RELAXATION EN PROGRAMMATION CONVEXE]
Bernard Martinet Apr. 1968 19 p refs In FRENCH; ENGLISH summary
(CEA-R-3483) Avail: CFSTI

Consideration is given to the determination of the minimum of a convex function S(x) of x belonging to R^n with the constraint $x \geq$. Relaxation methods are developed which can be considered as an extension of the case of mutual algorithms without constraint to the case of ones with the above constraint: during each iteration, for each component computed with the initial process, the result is conserved if it is non-negative, otherwise it is equal to zero. Sufficient convergence conditions are given for a certain class of these methods and the results are applied to the construction of optimization methods. In particular, the case of a quadratic non-negative definite function is studied (generalization of the Hildreth' method).
Author (ESRO)

N69-19892*# Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
INTERPOLATIONS WITH A SPLINE FUNCTION
S. W. Kahng Jun. 1968 16 p Revised
(Contract NAS9-5384)
(NASA-CR-99577) Avail: CFSTI CSCL 12A

Necessary and sufficient conditions for a spline term to interpolate a given function at two points, and to interpolate the function and its derivative at the given point are found. In both cases, the knot is chosen out of an interval. Conditions for the above cases are equivalent when the given function is differentiable.
Author

N69-19907 Michigan Univ., Ann Arbor
COMMUTING FLOWS AND VECTOR FIELDS
Walter Richard Tape (Ph.D. Thesis) 1968 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-13415

Two C^∞ vector fields on a manifold M commute if their Lie bracket is zero. It is shown that a maximal set of commuting C^∞ fields is a vector space. If the set contains fields $X_1, \ldots, X_n$ which are independent at all points of a dense subset U of M, then the maximal set has dimension $\leq nk$, where $n = \dim M$ and k is the number of components of U. An affirmative answer is given to the question: Must M admit C^∞ commuting fields $Z_1, \ldots, Z_n$ which are independent on a dense subset? Dissert. Abstr.

N69-19910 Vanderbilt Univ., Nashville, Tenn.
ALGEBRAS SATISFYING THE DESCENDING CHAIN CONDITION FOR SUBALGEBRAS
Thomas Paul Whaley (Ph.D. Thesis) 1968 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-12800

This study is concerned primarily with the existence of algebras of a given cardinality which have finitely many operations and satisfy the descending chain condition for subalgebras. It is shown that such an algebra exists having power m^+ if one exists having power m. From this it follows that for any $n \in \omega$ there is an algebra of power ω_n which satisfies the descending chain condition for subalgebras. In fact, it is shown that there are such algebras which are also locally finite. It is shown that if m is an infinite regular cardinal and if L is a lattice of power m, then there is at most two elements of L which are not contained in the complement of some sublattice of L which has power m. (An example is given to show that regularity is necessary here.) It follows that no infinite lattice satisfies the descending chain condition for sublattices. Dissert. Abstr.

N69-19928 California Inst. of Tech., Pasadena.
CONSTRUCTION OF SOLUTIONS TO PARTIAL DIFFERENTIAL EQUATIONS BY THE USE OF TRANSFORMATION GROUPS
George Wallace Bluman (Ph.D. Thesis) 1968 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-12729

A systematic approach is given for finding similarity solutions to partial differential equations by the use of transformation groups. If a one-parameter group of transformations leaves invariant a partial differential equation and its accompanying boundary conditions, then the number of variables can be reduced by one. In order to find the group of a given partial differential equation, the "classical" and "non-classical" methods are discussed. Initially no special boundary conditions are imposed since the invariances of the equation are used to find the general class of invariant boundary conditions. Next exact solutions to the heat equation are derived. In addition, new exact solutions are found for the transition probability density function corresponding to a particular class of first order nonlinear stochastic differential equations. The equation of nonlinear heat conduction is considered from the classical point of view. Dissert. Abstr.

N69-19929 New York Univ., N. Y.
BRAID GROUPS AND THEIR RELATIONSHIP TO MAPPING CLASS GROUPS
Joan Sylvia Birman (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-13107

The algebraic and geometric properties of braid groups on arbitrary manifolds are studied. A new meaning is given to the Fox braid groups by relating them to the mapping class groups of the manifold. Using results on the homotopy groups of configuration spaces, a systematic procedure is developed for determining generators and defining relations for the group of n-braids on any compact 2-manifold, or on any such manifold with m punctures. At the same time the method indicates the algebraic structure of the groups so obtained. The algebraic connection between braid groups and mapping class groups is studied. A method is indicated for finding a presentation for the subgroup of the mapping class group which is identified with the braid group. Dissert. Abstr.

N69-19933 New York Univ., N. Y.
ON THE USE OF INFINITESIMAL TRANSFORMATIONS TO FIND THE RIEMANN (-GREEN) FUNCTION
Edward Arthur Daggit (Ph.D. Thesis) 1968 78 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-13115

Lie found canonical forms for a second order hyperbolic partial differential equation $L_{xy}u = 0$ which is left invariant by one or more infinitesimal transformations of the form: $x \rightarrow x + \alpha f(x)$ $y \rightarrow y + \alpha g(y)$. If the adjoint operator of L_{xy} is L^*_{xy}, the Riemann (-Green) function $R(x,y,\Xi,\eta)$ for L_{xy} satisfies $L^*_{xy}R = 0$, $L_{\Xi\eta}R = 0$, and initial conditions along the characteristic lines. An application of Lie's procedure to these partial differential equations for R leads not only to canonical forms for the equations, but in certain favorable cases to a complete solution for R. Dissert. Abstr.

N69-19938 California Inst. of Tech., Pasadena.
FORMAL LANGUAGES, PART THEORY, AND CHANGE
David Bernard Benson (Ph.D. Thesis) 1968 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-12728

A general definition of interpreted formal language is presented. The notion "is a part of" is formally developed and models of the resulting part theory are used as universes of discourse of the formal languages. It is shown that certain Boolean algebras are models of part theory. The structure imposed upon the universe of discourse by a formal language is characterized by a group of automorphisms of the model of part theory. If the model of part theory is thought of as a static world, the automorphisms become the changes which take place in the world. Abstraction and the concept of definability are discussed. A Galois connection between the groups characterizing formal languages and a language-like closure over the groups is determined. It is shown that a set theory can be developed within models of part theory such that certain strong formal languages can be said to determine their own set theory. Dissert. Abstr.

N69-19939 University of Southern Calif., Los Angeles.
A GEOMETRIC INTERPRETATION OF STIEFEL-WHITNEY CLASSES FOR PL-MICROBUNDLE
Yen Wu Chao (Ph.D. Thesis) 1968 43 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-12027

For piecewise linear microbundles one can in fact define certain kinds of partial obstructions, and, by using these, one obtains a geometric description of the hitherto algebraically defined Stiefel-Whitney classes. The construction process is similar to that used to define Stiefel-Whitney classes for differentiable manifolds. The c.s.s. group complex PL_n plays a role in combinatorial manifolds analogous to the role of orthogonal group O(n) in differentiable manifolds. Dissert. Abstr.

N69-20065 Purdue Univ., Lafayette, Ind.
CERTAIN EXTENDED POST CANONICAL SYSTEMS RELATED TO CONTEXT-SENSITIVE LANGUAGES

William Henry Hosken (Ph.D. Thesis) 1968 56 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-12565

An extension of Post canonical systems is developed to serve as a framework for discussing some relationships between various sorts of language accepting and production devices. It is shown that both the class of context-sensitive languages and the class of their complements is contained in the class of languages accepted by deterministic automata which have one linear-bounded tape and a push-down store. Also the context-free grammars are shown to be closely related to multi-premise grammars with rules of the form $A_1X_1, A_2X_2, \ldots, A_nX_n \rightarrow Bw$ where $B, A_i, i = 1,2,\ldots,n$ are auxiliary letters and w is a word consisting of terminal letters and a single occurrence of each X_i, $i = 1,2,\ldots,n$. Finally, it is shown how rules of the form $Xb \rightarrow Xc$ may be replaced by rules $b'X \rightarrow c'X$ in systems of rules of the form $aX,bX \rightarrow cX$ or $Xb \rightarrow Xc$; where a,b,c are words and X is a production variable. Dissert. Abstr.

N69-20067 Ohio State Univ., Columbus.
WEAK AND STRONG CONSTRUCTIONS IN PROXIMITY SPACES
Louis Jack Nachman (Ph.D. Thesis) 1968 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-12862

The purpose of this dissertation is to carry out constructions similar to those which have been done for uniform spaces and study their properties. In order to do this it has been necessary to use the collection of δ-entourages, $P(\delta)$, for a given proximity space. It appears that, in attempting proximal constructions similar to those which have been made in topological spaces and uniform spaces, two constructions will generally be possible. The weak construction will correspond to the totally bounded uniform structure $U(\delta)$ and the strong construction will correspond to the collection of δ-entourages. The classes $U(\delta)$ and $P(\delta)$ are used to introduce weak and strong proximity relations on the space of all subsets of X where (X,δ) is a proximity space. The two key theorems used are generalizations of a theorem due to Kelley. Strong and weak constructions of proximities for function spaces are studied. A conjecture of Leader concerning the equivalence of two types of convergence of functions into a proximity space is shown to be correct. The results seem to parallel the known results of similar constructions for uniform spaces. Dissert. Abstr.

N69-20068 Ohio State Univ., Columbus.
CONTRIBUTIONS TO HAYES INTEGRAL
Huay-min Huoh Pu (Ph.D. Thesis) 1968 99 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-12869

In 1962, C. A. Hayes, Jr. developed a theory of integration with respect to a set-function more general than a measure. To be precise, let a family α of subsets of a fixed non-void abstract set S and a nonnegative, real-valued set-function ϕ defined on α be given. If α and ϕ satisfy the following properties: (a) there exists a countable subfamily of α whose union is the set S, (b) α is closed under the formation of differences (this property implies that α is closed under the formation of finite intersections) and (c) for A_1 and A_2 in α, the inequality $\phi(A_1) \geq \phi(A_1 \cap A_2) + \phi(A_1 - A_2)$ holds, then he defined a process of integration. The present paper shows that Hayes' integration process and results are still valid under more general hypotheses and establishes certain new and interesting properties of his integrals without using his additional condition. Dissert. Abstr.

N69-20069 Missouri Univ., Columbia.
DIFFERENTIAL-DIFFERENCE EQUATIONS OF ADVANCED TYPE
Clifford Harold Anderson (Ph.D. Thesis) 1968 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-12481

Consider the equation $y'(x) = f(x,y(x), y(x+h_1), \ldots, y(x+h_p))$ where $0=h_0 < h_1 < \ldots < h_p < \infty$. Three existence theorems are given. Two of them give uniqueness results. A non-existence theorem is obtained which pertains to a large subclass of the non-linear equations discussed by Wright. Four oscillation theorems are given for solutions to the equation $y'(x) = -a(x)f(y(x+1))$. The characteristic roots to the equation $y'(x) = -ay(x+1)$ are examined and a standard method for obtaining a particular solution is extended to apply to $y'(x) = ay(x+1) + g(x)$ for a certain class of forcing terms g(x). An expansion theorem is obtained which gives all solutions in terms of a particular solution and a series of characteristic solutions. For a large class of forcing terms g(x), the particular solutions arise in a natural way. Dissert. Abstr.

N69-20096 Ohio State Univ., Columbus.
OPTIMUM FINITE SEQUENTIAL PATTERN RECOGNITION USING THE MAXIMUM PRINCIPLE OF PONTRYAGIN
Marvin Harvey Hammond, Jr. (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-12842

This thesis is concerned with the application of Pontryagin's Maximum Principle to the pattern recognition problem where it is desired to find the best sequence of measurements to be taken in order to recognize an unknown pattern. The best order is the one which minimizes a performance functional which includes the various costs that can arise in the problem. Specifically this functional is composed of the actual costs incurred in taking the measurements, the penalties that result when an incorrect decision is made as to the pattern class membership, and a measure of the progress toward reaching a conclusion about the membership. Dissert. Abstr.

N69-20098 Weapons Research Establishment, Salisbury (Australia).
THE APPLICATION OF DIRECT SEARCH AND DESCENT METHODS OF FUNCTION MINIMIZATION TO PARAMETER ESTIMATION
J. F. Curtin Sep. 1968 57 p refs
(WRE-TN-SAD-205) Avail: CFSTI

The parameter estimation problem considered is the complete identification of a system transfer function when its functional form is known. A performance index which is a function of the unknown parameters is generated, and some theoretical aspects of the application of direct search and descent methods of function minimization to a parameter estimation are examined. The results of comparative tests of some representative methods, applied to various transfer functions with typical excitation, are described. These results point out the relative merits of the methods and give a guide to the degree of confidence that can be placed in the parameter values derived. Author

N69-20100 New York Univ., N. Y.
PL INVARIANTS ON A SMOOTH MANIFOLD
Joseph Roitberg (Ph.D. Thesis) 1968 40 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-13139

For a smooth manifold, one defines the integral (resp. rational) Pontryagin classes; these form a sequence of integral (resp. rational)

cohomology classes of the manifold depending on the (stable) tangent vector bundle of the manifold. If one considers another smooth manifold which is PL-homeomorphic to the original manifold, its Pontryagin classes may be different from those of the first manifold because the two tangent vector bundles may be inequivalent. However, it turns out that the rational classes are identical for the two manifolds; this fact was proved by R. Thom in 1957. The situation concerning the integral classes is more complicated. It is known only that the corresponding Pontryagin classes become equal after multiplying each by some positive integer. More precisely, if the tow PL-homeomorphic manifolds are denoted by M, M' and the k^{th} Pontryagin classes of M, M' by $p_k(M)$, $p_k(M')$, then there exists $c_k > 0$ (c_k depends only on k, not on M, M') such that $c_k \cdot p_k(M) = c_k \cdot p_k(M')$, (k = 1,2,3, . . .). The problem then is to determine, or at least to estimate, the integers $c_1, c_2, c_3, \ldots$ (assuming these are the minimal numbers with the above property). Dissert. Abstr.

N69-20101 Carnegie-Mellon Univ., Pittsburgh, Pa.
DISCONJUGACY AND DISFOCALITY OF DIFFERENTIAL SYSTEMS
Woo Jong Kim (Ph.D. Thesis) 1968 73 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 68-10710

Some sufficient conditions for system-disconjugacy of the vector-matrix equation $\underline{y}' = A(z)\underline{y}$ are obtained. Then these conditions are shown to lead to sufficient conditions for the disconjugacy and disfocality of the equation of the type $y^{(n)} + p_{n-1}(z)y^{(n-1)} + \ldots + p_0(z)y = 0$. Special attention is given to the case of the special equation $y^{(n)} + p(z)y = 0$, in which stronger results are possible. Also discussed is a criterion for the non-existence of a double zero of the solutions of the equation $y''' + p(z)y = 0$. Finally, some relations between the disconjugacy of the equation $y''' + p_1(z)y' + p_0(z)y = 0$ and the functions $f(z) = y_2(z)/y_1(z)$ and $g(z) = y_3(z)/y_1(z)$, where $y_1(z)$, $y_2(z)$, and $y_3(z)$ are linearly independent solutions of the equation, are derived. Dissert. Abstr.

N69-20102 Purdue Univ., Lafayette, Ind.
COMPUTATIONAL ALGORITHMS FOR LINEAR DIFFERENCE EQUATIONS
Ramsay Vincent Michel Zahar (Ph.D. Thesis) 1968 135 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-12644

The problem of calculating the solutions of the general linear difference equation is considered. The modified Miller algorithms for three-term recurrence relations are extended to obtain effective procedures for computing the solutions of the linear difference equation of arbitrary order. The concept of continued fraction is generalized, leading naturally to a first algorithm for calculating a minimal solution which is subject to one linear condition. The existence of a maximal solution of the adjoint equation is a necessary and sufficient condition for the convergence of this algorithm. A second algorithm for calculating any subdominant solution is developed, and a sufficient condition for convergence in terms of the Wronskian minors is given. For equations with coefficients of the Perron–Kreuser type, the asymptotic behavior of the space of solutions of the adjoint equation is formulated. Dissert. Abstr.

N69-20107 New York Univ., N. Y.
ON THE GROUPS OF CERTAIN KNOTS AND LINKAGES
Peter Francis Stebe (Ph.D. Thesis) 1968 42 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-13143

Brauner's groups of certain knots and linkages are studied inductively. The assumption of residual finiteness appears too weak to make available a straightforward inductive proof, so that a possibly stronger property, π_c, is used as an inductive hypothesis. A group G is π_c if and only if for every pair g_1, g_2 of elements of G either $g_1 = g_2^t$ for some integer t or there is a normal subgroup N of finite index in G such that $g_1 \neq g_2^t \bmod N$ for all integers t. The principal theorem is that the free product of isomorphic π_c groups with a single cyclic subgroup amalgamated is π_c. An inductive treatment of Brauner's groups yields the fact that Brauner's groups are π_c. Corollary to the proof of the principal theorem, a proof that the non-abelian groups of Brauner have non-degenerate derived series is obtained. Dissert. Abstr.

N69-20111 University of Southern Calif., Los Angeles.
FIXED POINT THEOREMS FOR SET VALUED CONTRACTIONS
Jack Traver Markin (Ph.D. Thesis) 1968 47 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-12067

The existence of a fixed point is proven for set valued globally strict contractions on a complete metric space, which assume their values in the family of non-empty closed subsets of the space. In a restricted class of metric spaces the same conclusion is reached for set valued locally strict contractions. In the case of a parameterized family of set valued strict contractions, each having a unique fixed point, sufficient conditions are given for the continuous dependence of the fixed points on the parameter. Considerations are restricted to Hilbert space, in order to deal with set valued contractions which are not necessarily strict contractions. The main result is an extension of a theorem of Browder. It states that a contractive mapping of the closed unit ball B of a Hilbert space into the family of non-empty closed convex subsets of B has a fixed point. The proof of this theorem rests on the development of a set valued version of the concept of monotonicity. Dissert. Abstr.

N69-20112 Minnesota Univ., Minneapolis.
ON SINGULARITIES OF SUBMANIFOLDS OF HIGHER DIMENSIONAL EUCLIDEAN SPACES
John Alvord Little (Ph.D. Thesis) 1968 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-12271

Surfaces in E^4 are studied. Independent second order scalar invariants are found. It is observed that the scalar invariants are the invariants of a configuration; namely a point and an ellipse called the curvature ellipse. Principal axes are determined everywhere on the surface with the exception of certain singular points. These axes generalize the usual principal axes for surfaces in ordinary space. Specifically, a surface immersed in E^4 possesses a line element field well defined except at inflection points and points where the mean curvature vector vanishes. Also the surface possesses a field of pairs of orthogonal lines defined everywhere except where the curvature ellipse is a circle. Global theorems are stated. Dissert. Abstr.

N69-20131 Rensselaer Polytechnic Inst., Troy, N. Y.
EIGENFUNCTIONS OF RANDOM EIGENVALUE PROBLEMS AND THEIR STATISTICAL PROPERTIES
Reinhoud Hermanus van der Linde (Ph.D. Thesis) 1968 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilms $3.00 Order No. 68-13527

The eigenvalue problem is considered: (1) $Lu = \lambda Mu$, $U_i(u) = 0$, where L and M are linear differential operators of orders n and m, respectively, with $n > m \geq 0$. Some or all of the coefficients of L and/or M are stochastic functions. Let (2) $\langle L \rangle u = \lambda \langle M \rangle u$, $U_i(u) = 0$ be the mean problem associated with (1), and assume that the stochastic coefficients of $L_1 = L - \langle L \rangle$ and

$M_1 = M - (M)$ are small in comparison with those of (L) and (M). The eigenfunctions of (1) can then be approximated by means of a perturbation expansion in terms of the eigenvalues and eigenfunctions of (2) and the coefficients of L_1 and M_1. An expression for the variance F of these eigenfunctions is found, and in the case of the taut string with a stochastic density function the properties of F are closely investigated. Dissert. Abstr.

N69-20132 Wisconsin Univ., Madison.
CELLULARITY IN CERTAIN 3-MANIFOLDS
Stephen Peter Slack (Ph.D. Thesis) 1968 65 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 68-9129

Recent results of R. H. Bing and D. G. Stewart are generalized, giving necessary and sufficient conditions for certain compact subsets X in certain manifolds to be cellular. Considerable use is made of D. R. McMillan's theorem to the effect that for the sets X in question at least in the 3-sphere, neighborhood bases consisting of cubes-with-handles may be obtained. A set X in a 3-manifold M^3 (which may or may not have boundary) is a UV^∞ set in M^3 provided that for each open set U in M^3 there is an open set V in M^3 which lies in U, contains X and homotopically contracts in U to a point. In order that a compact set X in M^3 be cellular in M^3 it is necessary that it be a UV^∞ set in M^3.
Dissert. Abstr.

N69-20136# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
THE GIBBS-EINSTEIN TENSOR ANALYSIS WITH APPLICATION TO CONTINUUM MECHANICS AND CANONICAL FORMS OF GENERAL SECOND-ORDER TENSORS
Shunsuke Takagi Nov. 1968 38 p refs
(AD-680900; CRREL-RR-221) Avail: CFSTI CSCL 20/11

A new tensor analysis, called the Gibbs-Einstein tensor analysis, is developed based on the concept that directions are algebraic quantities subject to the rule of forming scalar products, tensor products, and linear combinations. The new tensor analysis is explained in this paper by way of reformulating continuum mechanics and the Hamilton-Cayley theorem in matrix theory. The latter reformulation yields an explanation of the deformation dyads introduced in the former reformulation. A scalar product of two deformation dyads yields the strain tensor, which is a thermodynamic state variable for thermodynamically reversible deformations. Mathematics dealing with directions in a flat space becomes much simpler and more understandable when the Gibbs-Einstein tensor expression is used. Author (TAB)

N69-20150# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
COMPUTATIONAL ASPECTS OF THE LINEAR OPTIMAL REGULATOR PROBLEM
A. Frederick Fath Dec. 1968 34 p refs *Its* Inform. Sci. 24
(AD-680878; D1-82-0798) Avail: CFSTI CSCL 12/1

This paper considers computational problems arising in the solution of the linear optimal regulator problem. The proposed solution for the constant feedback gain matrix is an adaption of the eigenvector solution proposed by many authors. Techniques are given which are numerically stable and do not require complex arithmetic. These techniques offer considerable savings in computation time and eliminate many of the problems that plague more conventional methods. Author (TAB)

N69-20156 Wisconsin Univ., Madison.
THE SOLUTION OF NON-CONVEX OPTIMIZATION PROBLEMS BY ITERATIVE CONVEX PROGRAMMING
Robert Ricardo Meyer (Ph.D. Thesis) 1968 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-10922

The results of Rosen are used to show how a number of other classes of problems in nonlinear programming may be handled by similar techniques, and sufficient conditions are given for convergence of the proposed techniques. A number of the convergence proofs utilize Kantorovich's theorem on the convergence of Newton's method for solving systems of nonlinear equations. The effect of only obtaining approximate solutions to the subproblems because of various sources of error is considered, and it is shown that most of the convergence results are still valid provided the approximate solutions satisfy certain inequalities. A large number of examples are presented, including one- and two-dimensional examples that illustrate various facets of the theory and rates of convergence, examples of classes of problems that can be handled by the proposed techniques, and computational results for a number of problems, including two-point boundary value problems and optimal control problems. Dissert. Abstr.

N69-20162 Michigan Univ., Ann Arbor.
MULTIPLIERS OF H^p SPACES
James Howard Hedlund (Ph.D. Thesis) 1968 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-13328

Let H^p denote the Hardy space of functions f analytic in the unit disc for which the functions $f_r(\theta) = f(re^{i\theta})$ are bounded in L^p-norm as $r \to 1$. A sequence of complex numbers $\lambda = \{\lambda(n)\}$ is a multiplier from H^p to H^q We study the multipliers from H_p to H^2. Our principal result is the sufficient condition: if $1 \leq p \leq 2$ and $q = 2p/(2-p)$. The problem, and the results obtained, generalize easily to multipliers of the spaces $H^p(G)$ for an arbitrary compact connected Abelian group G. An extension to H^p spaces of analytic functions of several complex variables is only partially successful. The multipliers from H^1 to the sequence spaces are studied briefly. Dissert. Abstr.

N69-20209# Aerospace Corp., San Bernardino, Calif. San Bernardino Operations.
A COMPUTER METHOD FOR PERSPECTIVE REPRESENTATION OF CURVES AND SURFACES
Bruce R. Kubert 30 Dec. 1968 45 p refs
(Contract F04701-68-C-0200)
(AD-680769; TR-0200(S9990)-2; SAMSO-TR-68-477) Avail: CFSTI CSCL 9/2

This report presents a relatively efficient method for computer generation of perspective plots of groups of objects. The objects are defined in terms of finite space curves and surface patches. A space curve is specified as a sequence of points in space with straight line connections between adjacent points. A surface patch is defined by specifying its coordinates at the mesh points of a curvilinear coordinate system contained within it. Author (TAB)

N69-20215# White Sands Missile Range, N. Mex. Atmospheric Sciences Research Office.
AN IMPROVED METHOD OF ERROR CONTROL FOR KUNGE-KUTTA NUMERICAL INTEGRATION
Randall K. Walters and Bernard F. Engebos Oct. 1968 26 p refs
(AD-681236; ECOM-5222) Avail: CFSTI CSCL 19/4

An improved method to control error in the classical Runge-Kutta numerical integration scheme has been uncovered. The method is readily adaptable to the solutions of the differential equations of motion of an unguided rocket. This report presents the theoretical aspects behind this method and an evaluation of its efficiency. Author (TAB)

N69-20222# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
AN APPROXIMATION OF STRAIGHT PRISMS WITH RECTANGULAR, PARALLELEPIPED, AND HEXAGONAL BASES BY A SUM OF GAUSSIAN SURFACES [EINE APPROXIMATION VON GERADEN PRISMEN MIT RECHTECKIGEN, PARALLELOGRAMMFOERMIGEN UND SECHSECKIGEN GRUNDFLAECHEN DURCH EINE SUMME VON GAUSSSCHEN FLAECHEN]
H. Wolff Sep. 1968 44 p In GERMAN; ENGLISH summary
(DLR-PB-68-58) Avail: CFSTI

For the determination of the hit and kill probabilities, integrals for a target area have to be calculated. The integrands appear as the product of a density function with an efficiency function. To each point of the target area a kill probability is attached by the efficiency function, which is zero beyond the target area. A method was derived in this paper to represent the efficiency functions by a sum of exponential functions, since, in the case of such a representation of the integrand, the integration may be made in a closed form. Author

N69-20231# Philco-Ford Corp., Blue Bell, Pa. Communications and Electronics Div.
UNSUPERVISED SEQUENTIAL CLASSIFICATION OF NONSTATIONARY TIME SERIES
Thomas J. Harley, Jr. Wright-Patterson AFB, Ohio AMRL Oct. 1968 42 p refs
(Contract AF 33(615)-2966)
(AD-680824; AMRL-TR-67-230) Avail: CFSTI CSCL 9/4

The problem of unsupervised sequential classification of nonstationary time series is formulated as a compound decision problem. The a priori class probabilities are assumed to be stochastically independent, time varying, and unknown. The class-conditional cumulative distribution functions of the random variable, X, are assumed to be of known parametric form, but with the parameter values unknown and time varying. A Bayesian approach is taken, employing an a priori distribution on the unknown parameters and class probabilities, which leads to a solution in terms of minimizing the sample conditional risk. If the unknown parameters and class probabilities are assumed to have Markov time dependence, then the nonstationary problem can be reformulated in terms of the problem of classifying stationary time series with known parameters and with known Markov dependence on the states-of-nature. Specific results are presented for two special cases - unknown, time varying a priori class probabilities, and unknown time varying mean. Author (TAB)

N69-20235*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
FILTERING FOR LINEAR DISTRIBUTED PARAMETER SYSTEMS
Harold J. Kushner [1968] 24 p refs
(Grants NGL-40-002-015; AF-AFOSR-693-67)
(NASA-CR-100365) Avail: CFSTI CSCL 12A

The systems to be considered are described by parabolic equations with white noise inputs. Interest is in conditions which guarantee that the random surface solution has certain smoothness properties, and interest is also in the smoothness properties of the conditional expectation. Such results are developed by using the Sobolev imbedding theorem. Author

N69-20243 California Univ., Davis.
ON NONABSOLUTE INTEGRATION IN TOPOLOGICAL SPACES
Willy John Wilbur (Ph.D. Thesis) 1967 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-12381

An investigation of the foundations of the P-integral, and the basic properties of semihereditary and stable systems of sets are presented. These include methods of obtaining semihereditary and stable systems, the existence of certain minimal semihereditary systems within a given semihereditary system, and criteria for the stability of semihereditary systems. The question of the independence of the axioms for a convergence is settled. It is found that K_1–K_5 do not imply K_6; while K_1–K_4 and K_6 are independent and imply K_5. In addition, a new convergence, which is called the monotone convergence, is described; general limit properties of convergences are investigated; and a procedure for obtaining from a given convergence a stronger convergence is presented.
Dissert. Abstr.

N69-20290*# Texas Univ., Austin. Engineering Mechanics Research Lab.
ON THE STABILITY OF INERTIAL SYSTEMS
J. K. Aggarwal, T. E. Mueller, and L. G. Clark Mar. 1967 11 p refs
(Contract NASB-18120; Grant NSF-GK-261)
(NASA-CR-100388; EMRL-RM-1023) Avail: CFSTI CSCL 12A

Some of the class of higher order systems are discussed which are obtained by coupling second order systems. Sufficient conditions are derived for such a coupled system to be stable. The controllability of the coupled system when each subsystem is forced, as well as the oscillatory behavior of the system is discussed. Author

N69-20315# RAND Corp., Santa Monica, Calif.
WHEN A QUEUE LOOKS THE SAME TO AN ARRIVING CUSTOMER AS TO AN OBSERVER
Ralph Strauch Dec. 1968 6 p
(AD-680744; P-3985) Avail: CFSTI CSCL 12/2

It seems intuitively reasonable that a queue with a Poisson arrival distribution should appear the same to an arriving customer as it does to an external observer, since the intuitive meaning of the Poisson arrival distribution is that the arrival of each customer is independent of anything else going on in the queue. This result has been used by various authors, but there does not appear to be a rigorous proof of it in the literature. The purpose of this note is to provide such a proof. Author (TAB)

N69-20324 Michigan Univ., Ann Arbor.
PROBABILISTIC ASPECTS OF MACHINE STRUCTURE THEORY
Gianfranco Raimondo Putzolu (Ph.D. Thesis) 1968 95 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-13382

In this report structure theory is examined from a probabilistic point of view. We are interested in questions such as: "Given a family of machines, how often would one expect a machine in the family to have a certain structural property?". Machine decomposition is analyzed along these lines. First of all we obtain a formula which characterizes the average decomposability of an n-state, p-input machine. Then the case of large machines (number of states $n \to \infty$) is considered. It turns out that for $n \to \infty$ almost all n-state, p-input machines have an unbounded number of decompositions if the input p increases as a function p(n) of the memory. Dissert. Abstr.

N69-20334 Purdue Univ., Lafayette, Ind.
THE USE OF PIECEWISE CONTINUOUS EXPANSIONS OF FUNCTIONS IN THE IDENTIFICATION OF NONLINEAR DYNAMIC SYSTEMS

Clyde Howard Sprague (Ph.D. Thesis) 1968 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-12623

The problem considered in this thesis is that of nonlinear system identification, in which an ordinary differential equation model is sought to represent a physical system whose description is initially unknown. A method has been developed to produce numerical values for coefficients required to characterize unknown quantities in the differential equations used to describe nonlinear, time invariant, lumped parameter, dynamic systems. The method is applicable to systems with several inputs and outputs and to systems containing nonlinear elements whose behavior may depend on several system variables. Special test inputs are used for the identification process. The method consists of minimizing the square of a quantity called the equation error. Dissert. Abstr.

N69-20351# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
REPORT ON THE KINEMATICS OF THE RIGID BODY [BEITRAG ZUR KINEMATIK DES STARREN KOERPERS]
J. Vdovic Sep. 1968 11 p refs In GERMAN
(NIJS-R-540) Avail: CFSTI

Several simplifications are presented for use in calculations of rigid body kinematics by means of the matrix, vector, and quaternion methods. As an example of application, the motion of electrons in electric and magnetic fields is calculated. Transl. by K.W.

N69-20354# Stanford Univ., Calif. Dept. of Statistics.
FORMAL BAYES ESTIMATION WITH APPLICATION TO A RANDOM EFFECTS ANALYSIS OF VARIANCE MODEL
Stephen L. Portnoy 20 Dec. 1968 59 p refs
(Contract Nonr-225(52))
(AD-681032; TR-142) Avail: CFSTI CSCL 12/1

Techniques of formal Bayes estimation are discussed and applied to the estimation of the components of variance in the one way layout random effects ANOVA model. Invariant formal Bayes estimators are presented and proved to be admissible in certain classes of invariant rules and also minimax. To do this a general sufficient condition for admissible in certain multiparameter problems is given and applied to the ANOVA problem. Numerical calculations of mean squared errors of various estimators are also presented, and these results help justify the recommendation of the formal Bayes estimators. Author (TAB)

N69-20376# California Univ., Los Angeles.
STABILITY OF FUNCTIONAL DIFFERENTIAL EQUATIONS OF NEUTRAL TYPE
Marianito A. Cruz and Jack K. Hale 1968 37 p refs
Contract Nonr-233(76))
(AD-681067) Avail: CFSTI CSCL 12/1

A functional differential equation of neutral type is a differential system in which the rate of change of the system depends not only upon the past history but also the derivative of the past history of the system. For example, the system (1.1) x dot (t) + A x dot (t - 1) = f(t,x(t),x(t - 1)) is a functional differential or differential difference equation of neutral type. It is the purpose of this paper to give sufficient conditions for the stability and instability of solutions of a large class of equations (1.1) in terms of functions similar to those occurring in the application of the second method of Liapunov to ordinary and functional differential equations of retarded type. The basic restriction on the class of systems is that the derivatives occur linearly with coefficients depending only upon t and that the difference operator associated with the equation is stable. Author (TAB)

N69-20383# Wisconsin Univ., Madison. Dept. of Statistics.
BAYESIAN STRATIFIED TWO-PHASE SAMPLING RESULTS: THE k CHARACTERISTICS
Norman R. Draper May 1968 13 p refs
(Contract Nonr-1202(17))
(AD-681034; TR-162) Avail: CFSTI CSCL 12/1

The authors had previously obtained some results concerning the optimum allocation of sampling effort among k strata at the second phase of a two phase sampling procedure, using information obtained from the first phase. One variable (or characteristic) was involved. Two different approaches were employed: a Bayesian posterior analysis and a Bayesian preposterior analysis. Two different allocation methods were derived and illustrated with some numerical examples, for cases where some or all of the nuisance parameters were unknown. The problem when all nuisance parameters are known had been discussed by Ericson. In this work the authors extend their results to the case of k characteristics. Author (TAB)

N69-20387# Texas Univ., Austin. Computation Center.
SOLVING SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS USING RESIDUE ARITHMETIC Interim Technical Report
Jo Ann Howell and Robert T. Gregory Jan. 1969 103 p refs
Grants DA-ARO(D)-31-124-G 1050; NSF-GB-442)
(AD-680909; ITR-17) Avail: CFSTI CSCL 12/1

The report contains a summary of the basic theorems from the theory of numbers relative to residue arithmetic. Analogous theorems for residue matrix arithmetic are proved and a complete algorithm for solving systems of linear algebraic equations using residue arithmetic is presented. Numerical results demonstrate the computational feasibility of the algorithm. Author (TAB)

N69-20406# RAND Corp., Santa Monica, Calif.
SOME THOUGHTS ON THE USE AND MISUSE OF STATISTICAL INFERENCE
Ralph E. Strauch Jan. 1969 19 p refs
(AD-681109; P-3992) Avail: Issuing Activity CSCL 12/1

The basic principle underlying all statistical inference is that one attempts to distinguish the process actually being observed from alternative possible versions of that process on the basis of expected differences in the outcomes produced by these versions. The use of predictive models which do not describe the behavior of the alternatives among which we wish to distinguish, or of techniques based on such models, is a clear violation of this principle. Author (TAB)

N69-20450# System Development Corp., Santa Monica, Calif.
ON THE PROBABILITY THAT X<Y WHEN X AND Y ARE DEPENDENT
Vrudhula K. Murthy and Bennat P. Lientz 21 Jan. 1969 17 p refs
(Contract F33165-67-1865)
(AD-681172; SDC-SP-3286) Avail: CFSTI CSCL 12/1

The paper is a generalization of earlier papers by Birnbaum and McCarty. Assuming that X and Y are independently distributed, Birnbaum and McCarty obtain distribution free upper confidence bounds for P(X < Y). In this paper, the Wilcoxon-Mann-Whitney Statistic for estimating p = P(X < Y) is generalized to the case where X and Y have an arbitrary joint bivariate distribution. The consistency and asymptotic normality of the statistics for estimating p are established based on a random sample (x sub i, y sub i), i = 1, 2, ... N of size N from the joint distribution F(x,y) of X and Y. A method of obtaining a distribution-free upper confidence bound for p is given. Some applications and extensions are discussed in the section on concluding remarks. Author (TAB)

N69-20495# Wisconsin Univ., Madison. Dept. of Statistics.
PERCENTAGE POINTS OF THE NORMAL SCORE LAYER RANK TESTS FOR INDEPENDENCE AND EMPIRICAL POWER COMPARISONS
G. K. Bhattacharyya, Richard A. Johnson and H. R. Neave Aug. 1968 22 p refs
(Contract Nonr-1202(17))
(AD-681024; TR-171) Avail: CFSTI CSCL 12/1

A class of nonparametric tests based on the third quadrant layer ranks has recently been studied by Woodworth in connection with the problem of testing for independence in a bivariate distribution. In the present work, exact one-sided rejection regions are tabulated for the normal score layer rank test which is asymptotically locally most powerful for positive dependence in the bivariate normal distribution. The cut-off points are tabulated for sample sizes n=4(1)9 and significance levels alpha=.10, .05, .025 and .01. Normal and Edgeworth approximations for the significance probabilities are also given. A simplified version of the normal score test is proposed and its rejection regions are tabulated. These tests are compared with the correlation coefficient test, Kendalls t test and Spearmans rank correlation test for independence by means of Monte Carlo evaluation of power employing 10,000 trials from each of three different types of bivariate distributions. Also included is a brief description of the computing aspects of the problem that may prove useful in similar studies. Author (TAB)

N69-20507# Wisconsin Univ., Madison. Dept. of Statistics.
MAXIMUM LIKELIHOOD ESTIMATION OF MULTIVARIATE COVARIANCE COMPONENTS FOR THE BALANCED ONE-WAY LAYOUT
Jerome Klotz and Joseph Putter Jun. 1968 13 p refs
(Contract DA-31-124-ARO(D)-462; Grant AF-AFOSR-1158-66)
(AD-681035; TR-166) Avail: CFSTI CSCL 12/1

Unbiased estimators of variance and covariance components for the balanced one-way layout have been extensively investigated in the literature. Unfortunately, they possess the unpleasant property of taking on inadmissible values such as negative variances and, more generally, non-positive-semidefinite covariance matrices. This in turn can lead to correlation coefficients that are imaginary or greater than one. In the univariate case, the maximum likelihood (m. l.) estimators, which are free from these drawbacks, have been derived by Herbach and shown elsewhere to have uniformly, and in many cases considerably, smaller mean square errors than the unbiased estimators. Hence it is of interest to consider m. l. estimation in the multivariate case. Searle computed the information matrix for the bivariate case, but did not derive explicit expressions for the estimators. In this paper, the maximum likelihood estimators for the general P-variate case are derived. The methods of computation are described, and explicit formulae are given for the bivariate case. Author (TAB)

N69-20511# Reza (F. M.), Syracuse, N. Y.
AN EXPOSITION OF HILBERT SPACE AND LINEAR OPERATORS FOR ENGINEERS AND SCIENTISTS
F. M. Reza Griffiss AFB, N. Y. RADC Dec. 1968 93 p refs
(Contract F30602-68-C-0062)
(AD-680791; RADC-TR-68-435) Avail: CFSTI CSCL 12/1

The vast and rapid advancement in telecommunications, computers, controls, and aerospace science has necessitated major changes in our basic understanding of the theory of electrical signals and processing systems. There is strong evidence that todays engineer needs to extend and to modernize his analytical techniques. The latest fundamental analytical approach for the study of signals and systems seems to have its roots in the mathematics of Functional Analysis. This report contains a birds-eye view of the elements of Hilbert spaces and their associated linear operators. The first chapter of the report gives an exposition of the most essential properties of Hilbert spaces. The second chapter presents the elements of linear operators acting on such spaces. The report is addressed to engineers and scientists interested in the theory of signals and systems. The applications of the theory will be undertaken in a separate report. Author (TAB)

N69-20522# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
A LINEAR FORMAT FOR RESOLUTION Interim Report
D. W. Loveland Dec. 1968 19 p refs
(Contract F44620-67-C-0058; Grant NSF GP-7064)
(AD-681170; AFOSR-69-0101TR) Avail: CFSTI CSCL 9/2

The Resolution procedure of J.A. Robinson is shown to remain a complete proof procedure when the refutations permitted are restricted so that clauses C and D and resolvent R of clauses C and D meet the following conditions: (1) C is the resolvent immediately preceding R in the refutation if any resolvent precedes R, (2) either D is a member of the given set S of clauses or D precedes C in the refutation and R subsumes an instance of C or R is the empty clause, and (3) R is not a tautology. Author (TAB)

N69-20528# Stanford Univ., Calif. Dept. of Statistics.
THE STATUS AND IMPACT OF RELIABILITY METHODOLOGY
Gerald J. Lieberman Jan. 1969 38 p refs Presented at the Res. and Technol. Conf. on Optimization Statistics, Simulation, and Inform. Processing, Washington, D. C., 11–13 Sep. 1968; sponsored jointly by ONR and George Washington Univ.
(Contract Nonr-225(53))
(AD-681028; TR-115) Avail: CFSTI CSCL 14/4

The paper presents the current status of reliability methodology, and describes its practical impact. Mathematical models of complex systems are analyzed, together with the combinational probability necessary to calculate the system reliability, or bounds on the system reliability. Component time to failure distributions are studied and lower confidence bounds obtained. Models of underlying physical processes which induce time to failure distributions are also investigated. Author (TAB)

N69-20531# Stanford Univ., Calif. Dept. of Statistics.
STATISTICAL TECHNIQUE IN CLUSTERING AND PATTERN RECOGNITION
Paul Switzer Oct. 1968 29 p refs
(Contract Nonr-225(52))
(AD-681029; TR-139) Avail: CFSTI CSCL 12/1

Several techniques in clustering and pattern recognition are examined and evaluated. In each the objective is to partition the elements of a specified population into subsets so that the partition meets conditions imposed by the problems. The basic metric employed is the distance between elements. The question of sampling techniques in clustering is investigated because total enumeration of partitions very quickly becomes inordinately high. Several specific examples are worked out. Author (TAB)

N69-20562# Wisconsin Univ., Madison. Dept. of Statistics.
MISSING VALUES IN MULTIRESPONSE NONLINEAR MODEL FITTING
Michael J. Cox, Norman R. Draper, and William G. Hunter
(Contract Nonr-1202(17); Grant NSF-GK-1055)
(AD-681036; TR-168) Avail: CFSTI CSCL 12/1

A method for handling missing data in multiresponse nonlinear model fitting is described and illustrated with examples. Author (TAB)

N69-20582# Stanford Univ., Calif. Dept. of Statistics.
OPTIMAL DESIGN OF SAMPLING FROM FINITE POPULATIONS: A CRITICAL REVIEW AND DEVELOPMENT OF NEW RESEARCH AREAS
Herbert Solomon and Shelly Zacks 4 Nov. 1968 56 p refs
(Contract Nonr-225(52))
(AD-681030; TR-140) Avail: CFSTI CSCL 12/1

A critical review of the design of sampling from finite populations is presented and new research areas are developed. A major motivation for this study is an attempt at conceptual aspects of estimating vectors rather than linear functions of the coordinates of vectors. Areas that receive attention, keeping in mind vector estimation are: (1) The theoretical foundations for designs of sampling procedures from finite populations; (2) Bayes and minimax designs for single (one-stage) and sample procedures; (3) Bayes and minimax designs for double (two-stage) and sequential procedures; (4) optimal designs in the multivariate case; (5) the admissibility of estimators and procedures; (6) the problem of sampling with varying probabilities. Author (TAB)

N69-20591# RAND Corp., Santa Monica, Calif.
MAXIMUM-LIKELIHOOD PREDICTION AND ESTIMATION FOR NONLINEAR DYNAMIC SYSTEMS
Dec. 1968 102 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(AD-680765; RM-5859-PR) Avail: CFSTI CSCL 12/1

A method is given for determining the system state using noise-corrupted observations of a non-linear dynamic invector process, with a numerical application to radar observation of a reentry body. The study examined the feasibility of numerically solving the vector-differential equations satisfied by the maximum-likelihood estimator. The maximum-likelihood estimate is that initial condition which minimizes a certain functional on itself, on the observation, and on the a priori statistics. Author (TAB)

N69-20592# RAND Corp., Santa Monica, Calif.
CURVES: A FIVE FUNCTION CURVE-FITTING COMPUTER PROGRAM
H. E. Boren, Jr. Dec. 1968 92 p
(Contract F44620-67-C-0045; Proj. RAND)
(AD-680762; RM-5762-PR) Avail: CFSTI CSCL 9/2

Description and listing of an all-FORTRAN IV program that makes least-squares determinations of the parameters of any of five mathematical functions selected by the user, given a set of observations on the dependent and independent variables of interest (up to 200 data points per curve). The functions available are those most commonly used in developing cost estimating relationships: line, parabola, power, asymptotic-power, and exponential. Up to three independent variables may be used for the line and power functions. The Y-intercept may be specified for the line, parabola, or asymptotic-power functions. The program is designed to be user-oriented and easily workable rather than to emphasize computational efficiency. Exact and unique solutions for the line and parabolic functions are obtained by standard algebraic methods. Since the other three choices are not linear in all parameters, they are solved iteratively: the power and exponential by a modified Gauss-Newton iteration, starting from the exact logarithmic solution (as described in AD-655 768), and the asymptotic-power function by a special iterative method. In addition to directions for program use, the report includes a discussion of the characteristics of the functions and mathematical considerations involved in nonlinear least-squares solutions. Author (TAB)

N69-20594# RAND Corp., Santa Monica, Calif.
ON THE PRINCIPLE OF EXCHANGE OF STABILITIES
Stephen H. Davis Dec. 1968 57 p
(Contract F44620-67-C-0045; Proj. Rand)
(AD-680761; RM-5695-PR) Avail: CFSTI CSCL 12/1

Proof is given of a perturbation theorem: A class of real, bounded (non-self-ajoint) perturbations of norm epsilon to real self-adjoint operators preserves the reality of the simple eigenvalues for epsilon sufficiently small. A bound is obtained on epsilon. Application is made to Benard convection with constant heat sources, radiation, particular time-dependent profiles, variable fluid properties, and nonlinear equations of state, and to instability of circular Couette flow for a range of gap widths. In each case the growth rate is the eigenvalue, and hence if epsilon is less than the critical value, traveling waves--whether growing or decaying-- are forbidden. Author (TAB)

N69-20618# New York Univ., N. Y. Lab. for Electroscience Research.
CONTROL SYSTEMS RESEARCH
Philip E. Sarachik Nov. 1968 16 p refs
(Grant AF-AFOSR-747-66)
(AD-681166; AFOSR-69-0028TR) Avail: CFSTI CSCL 12/1

Research effort concentrated on problems concerning optimal control of unknown systems and systems with inaccessible states, modelling of system dynamics and computational methods. Results are discussed. TAB

N69-20649# California Univ., Los Angeles. Numerical Analysis Research.
EXISTENCE, UNIQUENESS AND CONTINUOUS DEPENDENCE FOR HEREDITARY SYSTEMS
J. K. Hale and M. A. Cruz (Brown Univ.) 1968 32 p refs
(Contracts Nonr-233(76); DA-31-124-ARO(D)-355)
(AD-681066) Avail: CFSTI CSCL 12/1

An hereditary system is a system whose present state is determined in some way by its past history. In this paper, a class of hereditary systems is formulated which includes all functional differential equations of retarded type, Volterra integral equations and difference equations. The formulation does not include all functional differential equations of neutral type the basic restriction being that the derivative x dot occurs linearly in the equations. The report contains theorems of existence, uniqueness and continuation of solutions, as well as theorems on the dependence of solutions on initial data and parameters. Author (TAB)

N69-20662# California Univ., Los Angeles.
EXTENSION AND BEHAVIOR AT INFINITY OF SOLUTIONS OF CERTAIN LINEAR OPERATIONAL DIFFERENTIAL EQUATIONS
H. O. Fattorini [1969] 59 p refs
(Contract Nonr-233(76))
(AD-681361) Avail: CFSTI CSCL 12/1

Let E be a complex Banach space, A, B linear operators with domains D(A), D(B) dense in E and range in E. An E-valued function u(.) defined and twice continuously differentiable in t $\geq$ or $>$ 0 is said to be a solution of the operational differential equation (1.1) u double prime + Bu(t) + Au(t) = 0 in (0, infinity) if u(t) epsilon D(A), u(t) epsilon D(B), Au(.) and Bu(.) are continuous functions and (1.1) is satisfied everywhere in t $\geq$ or $>$ 0. The problem of obtaining global estimates for the solutions of (1.1) are discussed on the basis of the given hypotheses. Author (TAB)

N69-20664# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE SCREW CALCULUS AND ITS APPLICATIONS IN MECHANICS

M. F. Dimentberg Apr. 1968 162 p refs Transl. into ENGLISH of Vintovoe Ischislenie i Ego Prilozheniya V Mekh. (Moscow), 1965 p 1-199
(AD-680993; FTD-HT-23-1632-67) Avail: CFSTI CSCL 20/11

The author sets forth the basic propositions of screw calculus on the basis of the elementary apparatus of modern vector algebra and indicates certain of its applications. The book sets forth material from the theory of sliding vectors, the algebra of complex numbers of the form alpha + omega (alpha superscript 0) with a special multiplier omega that possesses the property omega squares = 0, the algebra of screws, fundamentals of the differential geometry of the rules surface, which are necessary for the kinematics of solids, the foundations of screw analysis, and, finally, certain data from the classical theory of screws in its geometrical aspect, with indication of a number of applications in mechanics. TAB

N69-20693# Max-Planck-Institute fur Physik und Astrophysik, Munich (West Germany).
FIXED POINT PRINCIPLES IN THE APPROXIMATION THEORY [FIXPUNKTSAETZE IN DER APPROXIMATIONSTHEORIE]
Bruno Brosowski Aug. 1968 45 p refs In GERMAN
(MPI-PAE/Astro-9/68) Avail: CFSTI

The application of various fixed point sets is demonstrated in the following approximation problem: For a given element f of a normed linear space R and a given partial amount V $\subset$ R, let an element v_0 from V be determined in such a manner that $\| f-v_0 \| \leq \| f-v \|$ is valid for all $v \in V$. Every such element v_0 is called a minimum solution for f in regard to V. The number of minimum solutions for f regarding V is designated with $P_V(f)$. Fixed point sets are now applied to examine questions of the existence and invariance of minimum solutions. In addition, characterization problems for sums in normed linear spaces are treated. The application results in conditions requiring the generalized Kolmogoroff criterion and the criteria for the convexity of masses in flat, convex spaces. Transl. by K.W.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N69-19733# Institut Royal Météorologique de Belgique, Brussels.
CLIMATOLOGICAL OBSERVATIONS [OBSERVATIONS CLIMATOLOGIQUES] Monthly Bulletin, Nov. 1968
1968 15 p In FRENCH and DUTCH
Avail: CFSTI

Data are given on the atmospheric conditions in Belgium during November 1968. ESRO

N69-19879* Environmental Science Service Administration, Asheville, N. C. National Weather Records Center.
AN EMPIRICAL ANALYSIS OF THE 10-15 KM MAXIMUM WINDS TO DETERMINE APOLLO AND AAP LAUNCH OPPORTUNITIES CAPE KENNEDY, FLORIDA
Harold L. Crutcher and Nathaniel B. Guttman Jan. 1969 557 p refs
(NASA Order H-76789)
(NASA-CR-61260) Avail: CFSTI CSCL 04B

The launch opportunity empirical probabilities at Cape Kennedy, Florida are presented. A launch opportunity is defined as an opportunity to launch a vehicle through the wind field of the 10 to 15 km region when certain specified prior conditions have been given for launching. Wind observations are available at 12 hour intervals. There may be one launch opportunity in each 12 hour period. The probabilities are presented for the number of opportunities for monthly reference periods. The periods range from one 12 hour interval to forty 12 hour intervals or twenty days. The probabilities are presented for both consecutive and non-consecutive opportunities. The empirical probabilities for no opportunity to launch a vehicle are also tabulated. Again, the consecutive and non-consecutive features are given for each month. The empirical probabilities are based on records available for the overall period from January 1956 through December 1963 for the Cape Kennedy area. Author

N69-19893*# Environmental Science Services Administration, Asheville, N. C.
MARKOV CHAIN TECHNIQUES FOR PREDICTING THE MAXIMUM WIND IN THE MAXIMUM DYNAMIC PRESSURE REGION FOR LAUNCHING SPACE VEHICLES
Harold L. Crutcher and Nathaniel B. Guttman Jan. 1969 78 p refs
(NASA Order H-76789)
(NASA-CR-61258) Avail: CFSTI CSCL 04B

Acceptable predictions of the maximum wind in the maximum dynamic pressure region for space vehicles over Cape Kennedy, Florida (10 to 15 km) are sought for 12-hour increments through the use of transition matrices of operating Markov chains. The concepts of information theory, entropy, and Markovity are presented. Empirical transition matrices are examined for stationarity and order of Markovity. The Markov models are compared to those of persistence and climatology. For winter and summer seasons predictions are made from each model and then verified. The test data are randomly selected from a period different from that used to construct the models. Problems encountered during the study and recommendations for future investigation are discussed. Author

N69-19927*# National Weather Records Center, Asheville, N. C.
THUNDERSTORM PERSISTENCE AT CAPE KENNEDY, FLORIDA
Russell F. Lee, James W. Ownbey, and Frank T. Quinlan Jan. 1969 70 p refs
(NASA Order H-76789)
(NASA-CR-61259) Avail: CFSTI CSCL 04B

The probabilities and conditional probabilities of sequences of days with and without thunderstorms at Cape Kennedy, Florida, are determined for given months and seasons, and for specified periods of the day. These periods are as follows: (1) each hour of the day beginning with 0000 to 0059 EST (for thunderstorm probabilities only); (2) the 4-hour periods 0000 to 0359, 0400 to 0759, 0800 to 1159, 1200 to 1559, 1600 to 1959 and 2000 to 2359 EST; (3) the 8-hour periods 0000 to 0759, 0400 to 1159, 0800 to 1559, 1200 to 1959 and 1600 to 2359 EST; and (4) the 24-hour period 0000 to 2359 EST. Data used in this study are for the period January 1957 through December 1962. Conditional probabilities of sequences of thunderstorms are computed for all times except the one-hour periods. The highest wind speeds associated with thunderstorms are examined for the 24-hour period for each month and season of the year and for the period 1200 through 1959 EST for June, July, and August and for the summer season only. Author

N69-19937 Pennsylvania State Univ., University Park.
WIND AND TEMPERATURE FLUCTUATIONS IN THE SURFACE LAYER
B. A. Deva Guru Prasad (Ph.D. Thesis) 1967 83 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-12002

The dependence of the turbulence statistics, such as the normalized standard deviations of wind components and temperature, on stability is examined with data from various sites, and the validity of the postulates of similarity theory is tested. Only the fluctuations of vertical velocity and temperature agree with the predictions of similarity theory. Part of the analysis consists of the estimation of the magnitude of turbulent fluctuations under various stability conditions. On the basis of the fluctuations as functions of stability and the wind profile formulation, a practical method of estimation for these fluctuations is suggested. Nomograms are presented for the standard deviation of vertical and azimuth angles, and the relative intensity of turbulence of the longitudinal component of wind speed. Dissert. Abstr.

N69-20008 Washington Univ., Seattle.
METEOROLOGICAL OBSERVATIONS WITH PASSIVE MICROWAVE SYSTEMS
William Thomas Kreiss (Ph.D. Thesis) 1968 213 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-12700

Analysis is confined to the wavelength range 1 to 2 centimeters where a single, weak, collisionally broadened, purely rotational absorption line of the water vapor molecule is the dominant feature which permits remote sounding of the atmosphere in this wavelength range. A method of solving the equation of radiative transfer which is direct, and meaningful is developed in detail and the resulting numerical expressions are employed for computations with atmospheric models. Calculations of upward and downward viewing brightness temperatures over land and water for clear and clouded atmosphere are presented. Design details of a radiometer constructed specifically for this study and operating at 1.6 cm wavelength are described. It is concluded that absorption theory can explain many observations, that significant tropospheric measurements can be made with passive microwave systems, and that such systems can become important meteorological tools if properly exploited. Dissert. Abstr.

N69-20025* National Weather Records Center, Asheville, N. C. Environmental Data Service.
PREDICTION OF THE MAXIMUM WIND SPEED IN THE 10-15 km LAYER ABOVE CAPE KENNEDY
H. L. Crutcher, J. A. Almazan, and Frank T. Quinlan Jan. 1969 302 p
(NASA Order R-76789)
(NASA-CR-61257) Avail: CFSTI CSCL 04B

Tables are presented for the prediction of the maximum wind speed in the 10–15 km. layer above Cape Kennedy, Florida. These tables contain conditional probabilities based on eight years of data. The tables are presented by month. These permit the selection of probabilities that the maximum wind speed will be above or below a selected criterion for a specified period of time provided that the maximum speeds have been above or below the same speed criterion for certain periods of time. No attempt was made to place bounds of confidence on the probabilities. Author

N69-20084 Michigan Univ., Ann Arbor.
THE UTILITY OF SATELLITE CLOUD PHOTOGRAPHS IN OBJECTIVE ANALYSIS OF THE 500-mb HEIGHT FIELD
Christopher Mallett Hayden (Ph.D. Thesis) 1968 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-13325

This study was conducted to investigate the feasibility of modifying the analysis of the 500-mb height field by reference to cloud formations visible in satellite photographs. A technique is developed whereby the height-tendency field, either instantaneous or averaged over twelve hours, is adjusted by comparison with the cloud pictures. Through the modified tendency field, alterations are made to the twelve-hour forecast height field, valid at analysis time, which serves as the first guess for the objective analysis routine. The reanalyzed forecast fields are evaluated with respect to improvement in the initial guess and effect on the final product of an objective analysis system. It is shown that although reanalysis by bogus station input remains inconsequential, input by an adjusted first-guess field can be effective in the final analysis at station densities less than approximately one report per ten gridpoints (NMC grid). Dissert. Abstr.

N69-20090 Washington Univ., Seattle.
AN APPLICATION OF SOME STATISTICAL TECHNIQUES TO THE STUDY OF EDDY STRUCTURE
Joshua Zalman Holland (Ph.D. Thesis) 1968 398 p
Avail: Univ. Microfilms: HC $18.00/Microfilm $5.10 Order No. 68-12694

Techniques were used to detect a variety of structural features in time series of fast response meteorological data, with 11 tests consisting of one hour runs of 1 sec readings for u, v, w, and T at 16 or 40 m and also on random noise data. After eliminating wild readings, each series was filtered into four bands containing periods roughly 10 min or longer, 1 to 10 min, 10 sec to 1 min, and less than 10 sec. First and second time derivatives, running variances and covariances representing time varying high frequency eddy energy and fluxes, and low-pass total velocity were computed at each filter period. Individual probability density functions and moments for each variable, joint density functions and moments for many pairs of variables, and conditional means of other variables as functions of each pair were computed in each band, and contour charts drawn. Linear and curvilinear dependences, skewness, peakedness, multimodality and other non-normal features were observed. The eddy kinetic energy, measured by the sum of the running variances of the three velocity components, showed a high-probability low turbulence mode and one or more low probability high turbulence modes in most cases. The high-turbulence mode was associated with large long period updrafts in thermal turbulence (unstable conditions) and was more pronounced at 40 than at 16 m. Dissert. Abstr.

N69-20133# Joint Publications Research Service, Washington, D. C.
ARTIFICIAL MODIFICATION OF CLOUDS AND FOGS
V. Ya. Nikandrov 20 Feb. 1969 15 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 218, 1967 p 251-260
(JPRS-47498) Avail: CFSTI

An overview is presented on Soviet studies in experimental meteorology and the development of artificial weather modification methods which were started in 1919. Mention is made of techniques for estimating liquid water content, drop size distribution, ice particle distribution, droplet charge, concentration of condensation nuclei, and optical density. The use of solid carbon dioxide for modifying supercooled clouds and fogs is discussed in relation to experiments conducted to determine the mechanism of its effect on liquid drop moisture at low temperatures. It is reported that experiments in modifying supercooled clouds with aerosols of ice-forming substances (using aircraft, rockets, and various kinds of shells and powder charge igniters) showed the high crystallizing

activity of these reagents and confirmed the theoretical computations. Methods are also being studied for creating effective initial impulses for the development of descending movements in convective clouds; this would result in a subsidence of the cloud mass accompanied by its evaporation. M.G.J.

N69-20191# National Severe Storms Lab., Norman, Okla.
STRUCTURE AND MOVEMENT OF THE SEVERE THUNDERSTORMS OF 3 APRIL 1964 AS REVEALED FROM RADAR AND SURFACE MESONETWORK DATA ANALYSIS
Jess Charba (Oklahoma Univ., Norman) and Yoshikazu Sasaki (Oklahoma Univ., Norman) Oct. 1968 53 p refs
(ERLTM-NSSL-41) Avail: CFSTI

Detailed analyses of radar echoes, NSSL Beta network data, and upper air soundings recorded on 3 April 1964 are made to investigate possible mechanisms of the movement of severe thunderstorms. From the analyses, it is apparent that the direction and speed of storm movement correlate directly with low-level inflow as described and characterized by the surface patterns of wind, pressure, temperature, and humidity, and also with storm rotation as indicated by the motion of small storm echo elements. Storm speed and direction to the right or left of the mean tropospheric wind can be explained as a result of combined effects of storm rotation, drag, and propagation. Storm propagation is a result of a process of continuous intensification and subsequent displacement of convective activity to the side inflow side of the storm. Importance of the propagation process on the storm movement is demonstrated in the results of these analyses. Author

N69-20210# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
A NUMERICAL EXPERIMENT ON THE PROCESSES OF TOPOGRAPHIC PERTURBATIONS IN A BAROCLINIC ATMOSPHERE
Yong-ti Zhu Bedford, Mass. AFCRL Nov. 1968 17 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 32, no. 1, 1962 p 37–43
(Contract F19628-68-C-0251)
(AD-680837; EMM-68-170; AFCRL-68-0609; Trans-33) Avail: CFSTI CSCL 4/2

This report presents a numerical calculation by means of a three-level model of the distribution of zonal circulation of an ideal field under the influence of the processes of topographic perturbations for a time interval of 60 hours. The results reveal that the influence of topographic perturbations is characterized by a distinct time lag (it takes some 48 hours for the processes to attain a relatively stable state). On the other hand, the difluence of the banded flow around the Tibetan Plateau (detouring phenomenon) is significantly reflected in the calculated results. In the northern hemisphere, the positions of troughs and ridges induced by topography are basically concordant with those determined from the mean circulation pattern. This shows that realistic and appropriate boundary conditions have been included in the present study. Author (TAB)

N69-20223*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A PROBABILITY DISTRIBUTION FOR THE NUMBER OF THUNDERSTORM EVENTS AT CAPE KENNEDY, FLORIDA
Lee W. Falls 20 Feb. 1969 21 p refs
(NASA-TM-X-53816) Avail: CFSTI CSCL 04B

Determination of an underlying or basic theoretical statistical model for making probability inferences in regard to thunderstorm activity is presented. The negative binomial distribution with probability density function is presented to represent the variation in thunderstorm events per day. Statistical theory and methods are developed using the latest and most comprehensive data. The conclusion is reached that the negative binomial distribution is the logical choice for an underlying model to represent thunderstorm events at Cape Kennedy. Author

N69-20227 Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
THE INFLUENCE OF CORRELATION TIME OF FLUCTUATION FIELDS ON THE STOCHASTIC GROWTH OF WATER DROPLETS
Wen Ching-Sung Bedford, Mass. AFCRL Dec. 1968 24 p refs Transl. into ENGLISH from Ch'i-Hsiang Hsueh-Pao (Peking), v. 34, no. 3, 1964 p 369–377
(Contract AF 19(628)-5073)
(AD-680836; TRANS-35; AFCRL-68-0628) Avail: CFSTI CSCL 4/2

This report discusses the effect of correlation time on the growth of cloud droplets under the influence of fluctuation fields. The results reveal that the characteristic of the fluctuation field is an important parameter. The findings of the present study show that the correlation time of the turbulent acceleration field is too short to contribute directly to the formation of raindrops. A preliminary survey indicates that the fluctuation of liquid-water content contributes greatly to the growth of 30-50 mu droplets, and accelerates the process by more than half an hour in comparison with the uniform growth of the conventional model. Author (TAB)

N69-20389# Emmanuel Coll., Boston, Mass. Oriental Science Research Library.
THE INTERACTION BETWEEN BASIC CURRENT AND DISTURBANCES IN A BAROCLINIC ATMOSPHERE
Yung-san Chen Bedford, Mass. AFCRL Nov. 1968 25 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 34, no. 1, 1964 p 20–30
(Contract F19628-68-C-0251)
(AD-680838; EMM-68-177; AFCRL-68-0607; Trans-31) Avail: CFSTI CSCL 4/2

The vorticity and adiabatic equations are converted into a set of nonlinear ordinary differential equations, the integration of which is performed on a computer using the Runge-Kutta method. The results show that the basic current and the disturbances constrain each other, that the basic current alters quasi-periodically with periods of 10 to 13 days, and that the rate of change of basic current in each cycle is quite different. The disturbances of wave number six vary sinusoidally with a period of 11 to 13 days; the evolution of the disturbances of wave number four is complicated, and the disturbances of wave number two have a period of variation of about three days. The disturbances of wave number six develop or damp at the upper and lower levels simultaneously but the case is opposite for those of wave number four or two. The results also show that for nonlinear equations, the solution using different initial values contains different mean periods of index cycles. Author (TAB)

N69-20398 Hawaii Inst. of Geophysics, Honolulu.
RAINFALL PATTERNS IN HAWAII ASSOCIATED WITH UPPER-LEVEL CYCLONES, PART 2 Final Report
L. E. Worthley Aug. 1968 95 p refs
(Contract E-189-67(N))
(HIG-68-13-Pt-2) Avail: Issuing Activity

Sixteen years of upper-level cyclones are studied to determine frequency of occurrence of various categories of 24-hour rainfall as an aid to quantitative forecasting of rain in Hawaii. It is found that in general upper-level cyclones are poor rain producers, and

that the frequency patterns closely approximate the annual rainfall patterns. It is concluded that there is a definite orographic distribution of rain associated with these upper cyclones. Author

N69-20439# Air Force Cambridge Research Labs., Bedford, Mass.
A CLIMATOLOGY OF VERY HIGH ALTITUDE RADAR PRECIPITATION ECHOES Interim Scientific Report
A. J. Kantor and D. D. Grantham Dec. 1968 119 p refs *Its* AF Surv. in Geophys. No. 207
(AD-681107; AFCRL-68-0630) Avail: CFSTI CSCL 4/2

The frequency and percent occurrence of radar precipitation echoes from 50 to at least 70 kft over the United States is presented. Analyses of six years of data from a 31-station WSR-57 weather radar network indicate that probabilities of convective clouds are greatest over three regions: the Gulf Coast; a relatively narrow band northward through the central United States; and Florida. Largest probabilities at all levels and locations occur generally in summer, varying from May and June in central areas to August over south and southeast coastal regions. Based on mid-season months, maximum mean monthly probabilities are greater than 13% at 50-55 kft and nearly 1-1/2% at 60-65 kft near New Orleans in summer. In addition, precipitation echoes have been reported up to at least 70 kft at eight locations through the central United States in May through September, and up to 60 kft at a few Gulf coast stations in winter. Diurnal fluctuations at altitudes above 50 kft are such that largest probabilities are between 1600 and 2100 LST in all regions, with values approaching 10% at New Orleans and 7% at Tampa on an annual basis. Values for July are roughly three times larger than these at all stations. Author (TAB)

N69-20485# Weather Wing (3rd), Offutt AFB, Nebr.
AN INVESTIGATION OF SPRING FOG AND STRATUS AT WURTHSMITH AFB, MICHIGAN
Frank G. Johnson Jan. 1969 34 p
(AD-681146; Rept-3WW-TN-69-1) Avail: CFSTI CSCL 4/2

The report correlates wind, temperature and dewpoint depression with various categories of fog or status occurring during the morning or mid-day. Author (TAB)

N69-20490# Air Force Cambridge Research Labs., Bedford, Mass.
AN EVALUATION OF THE ALUMINUM OXIDE HUMIDITY ELEMENT
Frederick J. Boursaides Oct. 1968 54 p refs *Its* Instr. Papers No. 151
(AD-681105; AFCRL-68-0547) Avail: CFSTI CSCL 4/2

The electrical response of a number of aluminum oxide humidity elements to various conditions of humidity and temperature was examined. The limitations of these elements in meteorological application in the light of hysteresis effects and RH insensitivity are discussed. Author (TAB)

N69-20573# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS AND FORECASTING OF CLOUDINESS, FOG, WIND, AND TURBULENCE FOR AVIATION (SELECTED ARTICLES)
M. V. Rubinshtein and G. D. Reshetov Jun. 1968 50 p refs Transl. into ENGLISH from Tr. Tsentral. Inst. Prognozov (Moscow), no. 157, 1966 p 71-86
(AD-681272; FTD-MT-24-121-68) Avail: CFSTI CSCL 4/2

Contents: A comparison of altitudes of the lower cloud boundaries determined by an instrument and from an aircraft; Frontal cloud systems as observed from aircraft. TAB

N69-20680# Institute of Modern Languages, Inc., Washington, D. C.
THE THEORY OF A TURBIDIMETRIC BACK-SCATTERING INSTALLATION [TEORIYA NEFELOMETRICHESKOI USTANOVKI OBRATNOGO RASSEANIYA]
M. A. Golberg Fort Belvoir, Va. USAMERDC Jan. 1969 21 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Gidrometeorol. Priborostr. (USSR), no. 13, 1965 p 18-31
(Contract DAAK02-68-C-0396)
(AD-680776; T-1955-68) Avail: CFSTI CSCL 4/2

The article analyzes a series of theoretical problems connected with the operation of a backscattering turbidimetric installation. An equation for the determination of the meteorological visibility distance using a photometer was obtained, providing a polarization visibility counter of the M-53 type is used. A calibrated scale (curve) has been built, one of the possible procedures for the graduation of the installation is suggested and optimal values of basic parameters are recommended. Author (TAB)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N69-19603*# Houston Univ., Tex. Cullen College of Engineering.
LM RADAR REFLECTIVITY SIMULATION Final Report
H. S. Hayre, R. F. Chia, and J. Valerdi [1968] 97 p refs
(Contract NAS9-7828)
(NASA-CR-99540; TR-69-3) Avail: CFSTI CSCL 17I

An ultrasonic simulation of the radar reflectivity from LM radar was carried out for the LM lunar landing sites P-II-6 and 8 at 10, 20, 30 and 40 K ft. altitude for angles of incidence varying from zero to 50 degrees, as well as for Hummocks area (White Sands Missile Range) at zero and twenty degree angles of incidence at altitudes of 200 ft. to 1,000 ft. in 100 ft. intervals. The resulting radar cross-section with plus and minus are standard deviation values and were obtained by referring the data to a flat plate data at 10 K ft. for lunar surface models and to another flat plate at 1,000 ft. altitude for Hummocks area. The scale factor for Hummocks area was 500, and that for P-II-6 and 8 lunar landing sites was 6,850. In both cases wavelength reduced heights were used to model surface heights. The final results in both cases verify our previous theoretical and experimental work in that the means may vary as much as ± 1.5 db from a smooth reflectivity curve and that the plus and minus sigma values of the reflectivity may vary asymmetrically as much as ± 7 db depending on the altitude. Author

N69-19698*# Kaman Avidyne, Burlington, Mass.
A TERMINAL GUIDANCE SCHEME FOR LIFTING BODY ENTRY VEHICLES
William C. Hoffman, Arthur E. Bryson, Jr., and John Zvara Oct. 1968 89 p refs
(Contract NAS12-99)
(NASA-CR-86126; TR-55) Avail: CFSTI CSCL 17G

A simple perturbation feedback scheme is developed for guiding a lifting body entry vehicle during the terminal phase of flight. By observing that the velocity and flight path angle of typical lifting body vehicles become quasi-steady during subsonic flight, and by selecting altitude rather than time as the independent variable, one can reduce the number of state variables to three. The system may then be linearized by taking first-order perturbations about a nominal trajectory. Numerical results are presented for a typical vehicle performing both a straight-in approach and a 90°

turn followed by a straight glide. These results indicate that the scheme can successfully handle a variety of off-nominal conditions. Author

N69-19752# Federal Aviation Agency, Atlantic City, N. J.
TEST AND EVALUATION OF DECRAB DISPLAY SYSTEM Final Report
Robert H. Pursel Apr. 1969 39 p refs
(NA-69-6(RD-69-11)) Avail: CFSTI

A flight test evaluation, under simulated Category III conditions, was conducted on a three-axis attitude indicator. Heading error was presented on the third axis to be used in executing the decrab maneuver. The indicator was installed in a Federal Aviation Administration DC-7 aircraft and flight tests were conducted using four FAA flight test pilots. Data associated with the landing maneuver were collected and compared to similar data obtained from a previous evaluation of a decrab display which had been considered unsatisfactory. It was concluded that the new indicator offered on significant advantage over the previous indicator. It is recommended that investigation be made into the use of the pilot's peripheral vision channel to convey the decrab information. Author

N69-19763# Federal Aviation Agency, Atlantic City, N. J.
FLIGHT EVALUATION OF SEAL GLIDE-SLOPE RECEIVER Final Report
Jules E. Blazej Mar. 1969 35 p
(NA-69-24(RD-69-2)) Avail: CFSTI

Flight tests of two signal evaluation airborne laboratory (SEAL) glide-slope sensors (receivers) were conducted to evaluate the performance in a real world flight inspection environment. Output data were compared with that of two standard flight inspection glide-slope receivers. The quality of the SEAL data was determined to be higher than that of the flight inspection receivers. It was concluded that the SEAL receivers would perform satisfactorily in the SEAL system. Integration into the system was recommended. Author

N69-20277 Pennsylvania State Univ., University Park.
THE INVESTIGATION OF PROBABILISTIC INTERCEPT PROBLEMS USING A DIGITALLY CONTROLLED ANALOG COMPUTER
John Bye Ross (Ph.D. Thesis) 1967 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 68-12004

A computer model is developed which facilitates the study of the performance of intercept systems of the type that may be used to guide an object into coincidence with a target that is capable of performing random maneuvers about a deterministic path. The classes that may be handled consist of those systems that use proportioned navigation guidance methods. The guidance systems may be of the sampled data type. The model involves the two dimensional simulation of the trajectories of a target and an interceptor. For a given intercept system configuration, the problem was cycled through a prescribed number of intercept attempts or runs. The frequency of success from the number of runs provided an estimate of the probability of object coincidence. This process was repeated for different system parameter values, and the resulting index of performance curve was analyzed to determine the desired intercept system configuration. Special circuits and simulation techniques were developed to obtain a precision circular intercept contour of adjustable size. A method was devised to obtain the signals representing the target bearing rate without the use of differentiator circuits, allowing the use of a fast time scale. An example investigation of a particular sampled data intercept system was performed and results presented. Dissert. Abstr.

N69-20284*# General Dynamics/Convair, San Diego, Calif.
AC-16 FINAL GUIDANCE EQUATIONS AND PERFORMANCE ANALYSIS
R. E. Seiley Aug. 1968 133 p refs
(Contract NAS3-8711)
(NASA-CR-100366; GDC-BKM68-055) Avail: CFSTI CSCL 17G

The final guidance equations presented designed as a common set of explicit equations suitable for the ATS-D, E, OAO-A2 and Mariner '69 missions. The following information for the AC-16/OAO-A2 mission is presented: (1) trajectory, vehicle, payload, and hardware constraints or requirements that the equation design must satisfy; (2) the form of the equations, as mechanized for the vehicleborne computer, that satisfies the equation specifications and performance criteria; (3) a set of maximum deviations from critical trajectory, environmental, and payload capability parameters that fixes the standard for equation performance; (4) the required orbit parameters to which the equations must be targeted; (5) a specification of the trajectory simulations required for a comprehensive evaluation of guidance equation performance; (6) a presentation of the data obtained from the simulations specified in the test plan; and (7) a discussion of the method of targeting the AC-16 mission. An evaluation of the results of the performance analysis shows that all guidance equation specifications have been fulfilled. Author

N69-20320# Stanford Univ., Calif. Dept. of Statistics.
SHIP TRACKING VIA SATELLITE
Alan E. Gelfand Dec. 1968 37 p refs
(Contract NONR-225(52))
(AD-681031; TR-141) Avail: CFSTI CSCL 17/7

Under the assumption of complete ephemeris information about a satellite orbiting the earth, a ship wishes to estimate its location and velocity. The observations are range readings of the ship-to-satellite distance taken at several times. It is assumed that angular measurements are not available. Several methods are examined and successful resolution is achieved. No randomness in the measurements is considered. An error analysis is left for a future report. Author (TAB)

N69-20563# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLUTION OF A NONLINEAR PROGRAMMING PROBLEM
G. T. Kaichenko Apr. 1968 10 p refs Transl. into ENGLISH from Latvisas Par Zinatnu Akad. Fiz. un Tehn. Zinatnu Ser. (Riga), no. 3, 1966 p 93-96
(AD-680942; FTD-HT-23-1580-67) Avail: CFSTI CSCL 17/7

The article presents an approximate method for solution of the problem of maximization of a nonlinear separable function with two-sided limitations on the unknowns and the fixed common lower boundary of the modulus of the difference of the unknowns. The possibility of applying this method to some problems of air traffic control in high-density zones is shown. Appropriate data can be stored in the operative memory of a Ural-4 computer. Author (TAB)

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N69-19605# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
COATED-PARTICLE FUELS
T. G. Godfrey, R. L. Beatty, J. L. Scott, J. H. Coobs, J. W. Prados et al Nov. 1968 142 p refs
(Contract W-7405-ENG-26)
(ORNL-4324) Avail: CFSTI

Information was surveyed on fabrication, characterization performance, and reprocessing plutonium, thorium, or uranium coated-particle fuels with emphasis on pyrolytic carbon-coated oxides and carbides. Processes used in fabrication include powder rolling and sintering, particle melting and sol-gel. Properties of pyrolytic-carbon coatings and their dependancy on coating conditions are discussed. Radiation effects on mechanical properties and dimensional changes and fission product retention behavior are given. The burn-leach and grind-leach processed for fuel reprocessing are described. NSA

N69-19615# Oak Ridge National Lab., Tenn. Neutron Physics Div.
NEUTRON PHYSICS DIVISION Annual Progress Report, Period Ending 31 May 1968
Oct. 1968 194 p refs
(Contract W-7405-ENG-26)
(ORNL-4280) Avail: CFSTI

Progress in the nuclear and reactor physics research programs and the reactor and weapons shielding research programs is summarized, together with the activities of the Radiation Shielding Information Center. Developments in radiation detection and data-handling techniques are also outlined, as are theoretical studies for medium- and high-energy radiation shielding and experimental studies for medium-energy radiation shielding. NSA

N69-19616# Iowa State Univ. of Science and Technology, Ames.
A COMBINED CRYOSTAT-FLUX CONVERTER SYSTEM FOR REACTOR IRRADIATIONS IN LIQUID NITROGEN
C. W. Chen and R. G. Struss Aug. 1968 25 p refs
(Contract W-7405-ENG-82)
(IS-1917) Avail: CFSTI

A combined system of a cryostat and a flux converter was installed in one of the side vertical thimbles of the Ames laboratory research reactor. The cryostat operates on the thermosiphon principle and allows the irradiation experiments to be performed at temperatures between 80° and 870°K. In addition to varying and controlling the temperature of irradiation over such a wide range, the cryostat also makes it possible to conduct in-pile experimentation within the cylindrical dewar tube of 2.54-cm diameter. The flux converter, which lies peripherally around the bottom section of the dewar vessel of the cryostat, is constructed of CP-5 type fuel tubes from Argonne National Laboratory. Measurements of neutron flux conducted inside the dewar vessel indicate that the converter is capable of providing a constant fast neutron flux in the lower 30.5-cm section of the dewar vessel. The main design features and the performance characteristics of the combined system are described along with the conditions required for a safe and steady operation of the cryostat. Author (NSA)

N69-19631# Brookhaven National Lab., Upton, N. Y.
CALCULATION OF THE EFFICIENCY OF A SPHERICAL BETA-RADIATION SOURCE
R. V. Dzhagatspanyan, Yu. G. Lyaskin, L. I. Kheifets, V. I. Kosorotov, and V. I. Mukosey [1968] 6 p refs Transl. into ENGLISH from At. Energ. (Moscow), v. 24, 1968 p 580-582
(BNL-TR-239) Avail: CFSTI

An attempt is made to calculate the efficiency of a spherical beta radiation source encased in a cladding of an inactive material of the same density. Dose functions were obtained from Silverman's formulas, and numerical solutions were determined on a computer. The efficiency of the source is plotted as a function of its radius, while the efficiency of the cladding is plotted as a function of its thickness. NSA

N69-19680# Reactor Centrum Nederland, Petten.
REACTOR NOISE: A STUDY OF NEUTRONIC FLUCTUATIONS IN LOW-POWER NUCLEAR REACTORS, WITH SPECIAL EMPHASIS ON ACCURATE TIME-DOMAIN ANALYSIS
J. B. Dragt Oct. 1968 227 p refs
(RCN-101) Avail: CFSTI

The study of this thesis concentrates on reactor noise measurements with neutron-sensitive ionization chambers, use of digital measuring techniques, and analysis by means of digital computers. After an introduction, the theory of the kinetics and the noise of zero-power reactors, for several reactor models are given. The accuracy to be expected in reactor noise experiments (with one as well as two detectors) is calculated and the accuracy of parameters derived from the noise is also considered. Two-detector experiments are shown not to be essentially better. A detailed description of the experimental set-up is given on reactors, instrumentation, computer programs and analysis. Experimental results – mainly auto- and cross-correlation functions – are presented. For a simple reactor the results are compared with a simple theory. Generally a good agreement is found. Reactor parameters determined from the noise are corrected for space effects. For two coupled reactor cores the coupling factor is determined with good accuracy. In a third group of experiments the results of the correlation funtion analysis are compared with several other kinetic techniques. Finally the conclusions are summarized and practical applications are discussed. Author (ESRO)

N69-19683# Reactor Centrum Nederland, Petten.
CRITICAL EXPERIMENTS FOR THE GKN DODEWAARD NUCLEAR POWER STATION PERFORMED IN THE KRITO FACILITY OF RCN AT PETTEN
J. Smit and J. C. Bruggink Nov. 1968 33 p refs
(RCN-102) Avail: CFSTI

Critical experiments with fuel elements of the first Dutch nuclear power station are described. These experiments have been performed in the zero-power critical facility KRITO at R.C.N. After having determined a minimum critical fuel loading the reactivity effect of several fuel elements was measured. In these so-called substitution measurements it was found that the variation of the reactivity effect of these elements is negligible. In most cases the experimental horizontal power distribution is in close agreement with the theoretical distribution. The temperature coefficient has been measured in a core without control rod followers. From this measurement and from calculations where the followers were taken into account it is concluded that the temperature coefficient is negative above 25°C in the actual core of the power station. Author (ESRO)

N69-19712# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
FLICA: A CODE FOR THE THERMODYNAMIC STUDY OF A REACTOR OR A TEST LOOP [PROGRAMME FLICA: ETUDE THERMODYNAMIQUE D'UN REACTEUR OU D'UNE BOUCLE D'ESSAI]
Maurice Fajeau Jan. 1969 64 p refs In FRENCH; ENGLISH summary
(CEA-R-3718) Avail: CFSTI

This code concerns the thermal problems of water loops or reactor cores under the following conditions: a) high or low

pressure, steady state or transient behavior, one or two phases; b)three-dimensional thermodynamic study of the flow in cylindrical geometry; unidimensional study of heat transfer in heating elements. Neutron studies can be coupled and a schematic representation of the safety rod behavior is given. The number of cells described in a flow cross-section is presently less than 20. This code is the logical one following upon FLID and CACTUS of which it constitutes a synthesis. Author (ESRO)

N69-19727# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
THE OSCILLATION METHOD FOR MEASURING COLLISION CROSS SECTIONS FOR FISSION AND ABSORPTION IN THE RANA AND RITMO REACTORS [IL METODO DI OSCILLAZIONE PER LA MISURA DI SEZIONI D'URTO DI FISSIONE E ASSORBIMENTO NEI REATTORI RANA E RITMO]
E. Santandrea 1968 26 p refs In ITALIAN
(RT/FI(68)35) Avail: CFSTI

The oscillation method adopted in measuring effective fission and absorption cross sections is discussed. The application of the method is to be used in experiments with the RANA and RITMO reactors. For the latter, the experimental system allowing the oscillation of the central rod in a multiplying lattice placed in the central cavity of the reactor is illustrated. Author

N69-19780 Purdue Univ., Lafayette, Ind.
DEPLETION ANALYSIS OF MULTI-ZONE FAST BREEDER SYSTEMS
Thomas David Wolsko (Ph.D. Thesis) 1968 285 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.70 Order No. 68-12641

Nuclear power reactors use a number of different refueling schemes for plant operation. A desirable method for fast reactors is to use a single batch loading scheme, thereby eliminating fuel shuffling and frequent shutdowns for refueling. To investigate this refueling procedure, the breeding characteristics of a fast reactor were utilized to determine whether a single batch loaded core is a feasible refueling method. This fuel management method was examined for two irradiation limits (100,000 MWD/tonne and 200,000 MWD/tonne). A cylindrical reference design, which has a core height to diameter ratio of 0.2, was used. The central core (30 volume per cent oxide fuel, 50 volume per cent sodium, 20 volume per cent stainless steel) is surrounded by axial and radial blankets. The core is divided into six radial fuel zones of equal volume in which the fertile to fissile fuel ratio varies from 3.54 to 6.57. Dissert. Abstr.

N69-19790# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
URANIUM SELF-DIFFUSION IN URANIUM MONOCARBIDE [DETERMINATION DU COEFFICIENT D'AUTODIFFUSION DE L'URANIUM DANS SON MONOCARBURE]
Philippe Villaine (Ph.D. Thesis—Grenoble Univ., 23 Oct. 1967) Sep. 1968 54 p refs In FRENCH; ENGLISH summary
(CEA-R-3436) Avail: CFSTI

Uranium self diffusion in near-stoichiometric stabilized uranium monocarbide has been investigated in the temperature range 1450-2000°C. A thin layer of ^{235}UC was deposited onto samples and the diffusion profiles were analyzed by both sectioning and alpha-spectrometry techniques. The self-diffusion coefficient D decreases with increasing carbon content and varies with temperature according to an exponential law. Autoradiographs and profile analysis have shown a preferential grain-boundary diffusion at all temperatures and compositions investigated. This phenomenon was used for a study of grain-boundary migration and for the evaluation of grain-boundary diffusion coefficients. The activation energy thus derived is close to the volume diffusion activation energy. Author (ESRO)

N69-19815# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
THE AGE-DIFFUSION HETEROGENEOUS KERNAL IN A CYLINDRICAL REACTOR
A. Miasnikov Sep. 1968 6 p refs
(UJV-2072-R) Avail: CFSTI

The slowing-down density in nonabsorbing moderating medium with cylindrical boundary caused by the line source of fast neutrons is calculated. The Fermi's age theory is used. Further, heterogeneous age-diffusion kernel (slowing-down followed by diffusion) based on the previous result is calculated. Author (NSA)

N69-19817# Kernforschungszentrum, Karlsruhe (West Germany).
SAFETY REPORT ON THE COLD NEUTRON SOURCE AT FR2/16 [SICHERHEITSBERICHT FUER DIE KALTE NEUTRONENQUELLE AM FR2 PROJEKT FR2/16]
F. Spath, E. Karb and H. Oehme Jan. 1968 90 p refs In GERMAN; ENGLISH summary
(KFK-818) Avail: CFSTI

A cold neutron source will be installed in the horizontal hole R3 of the reactor FR2. This source mainly consists of a moderator chamber to be placed into the reactor reflector zone. It is filled with some 220 cm^3 of liquid H_2 and cooled by gaseous He in a He refrigeration system equipped with expansion turbines. An apparatus containing 1 standard m^3 of gaseous H_2 feeds the chamber, and a vacuum system provides the refrigeration isolation. The background of higher-energetic neutrons is reduced by a neutron filter made of Be which is mounted in the beam tube and cooled with liquid N_2. In order to avoid a reaction between H_2 and air as well as other conceivable hazards, a number of safety precautions were taken; besides, the H_2 chamber was surrounded by a pressure tube to protect the reactor core. The experimental facility is automatically controlled from the project control panel so that it may be temporarily operated without supervision. Any trouble will release a signal and appropriate measures will be initiated by safety circuits. In special cases, the H_2 system is evacuated or the reactor is scrammed. Author (NSA)

N69-19820# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR DEVELOPMENT PROGRAM Quarterly Report, May–Jul. 1968
G. R. Pflasterer, comp. Aug. 1968 31 p refs
(Contract AT(04-3)-540)
(GEAP-5673; QR-17) Avail: CFSTI

Topics discussed include: core flux detector system; fast reactivity excursion device (FRED); fabrication of fuel pellets of UO_2 and PuO_2–UO_2; startup testing; transient tests; and SEFOR operations and construction. NSA

N69-19821# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
OPTIMUM GAS DIFFUSION URANIUM ENRICHMENT PLANT [OTTIMIZZAZIONE DI UN IMPIANTO A DIFFUSIONE GASSOSA PER L'ARRICCHIMENTO DELL'URANIO]
F. Calori, G. B. Scuricini, and P. Venditti 1968 53 p refs In ITALIAN; ENGLISH summary
(RT/ING(68)21) Avail: CFSTI

An optimization is given in order to assess the different arrangements (squared and three/four steps squared-off cascade) for a 700 t U/y gaseous diffusion enrichment plant. Furthermore, the influence on the main design parameters of the plant is shown for different values of the assumed cost functions. Author

N69-19824# General Dynamics Corp., San Diego, Calif. General Atomic Div.
ADVANCED BERYLLIUM OXIDE CONCEPTS Quarterly Progress Report, Period Ending 31 December 1965
29 Jan. 1966 49 p refs
(Contract AT(04-3)-187)
(GA-6889) Avail: CFSTI

The development of the dispersion fuel using beryllium oxide as the matrix, the development of the design for the test module for EBOR, and conceptual design of fuel elements using the ceramic materials were investigated. NSA

N69-19960# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
DETERMINATION OF LOCAL BOILING IN LIGHT WATER REACTORS BY CORRELATION OF THE NEUTRON NOISE [DETERMINATION DE L'EBULLITION LOCALE DANS LES REACTEURS A EAU LEGERE PAR CORRELATION DU BRUIT NEUTRONIQUE]
Gilles Zwingelstein Dec. 1968 62 p refs In FRENCH; ENGLISH summary
(CEA-R-3686) Avail: CFSTI

The power limit of swimming-pool type reactors depends on the phenomenon of burn-out. In order to determine this limit an attempt to detect the local boiling which usually occurs before the burn-out was made. Local boiling was simulated by an electrically heated plate placed in the core of the reactor Siloette. The study of local boiling, which is based on correlation functions for the neutron noise of detectors placed in the core, shows that a privileged frequency occurs in the power spectrum of the noise. In the future it is intended to determine the influence of various parameters on this characteristic frequency. Author (ESRO)

N69-20015# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
AEC FUELS AND MATERIALS DEVELOPMENT PROGRAM Annual Report, 31 Jan. 1967–31 Jan. 1968
31 Mar. 1968 378 p refs
(Contract AT(40-1)-2847)
(GEMP-1004; AR-7) Avail: CFSTI

Fast breeder reactor studies cover the following topics: radiation effects on cladding and structural materials, fuel element cladding development and research, physical metallurgy of cladding materials and refractory metals, and thermocouple development. Also included are sections on the physical and mechanical properties of reactor materials, advanced pressure vessel materials, plastic fatigue properties of heat resistant alloys, physico-chemical studies of clad UO_2 in potential meltdown environments and of Fe–Cr–Al-clad fuel systems, and high temperature research on carbides for fuel and structural applications. P.A.B.

N69-20032# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
SPERT PROJECT Quarterly Technical Report, Oct.–Dec. 1967
T. G. Taxelius, ed. Oct. 1968 24 p refs
(Contract AT(10-1)-205)
(IDO-17279) Avail: CFSTI

Reactor safety experiments are reported. Transient testing of oxide E-core in Spert 3 was done at elevated initial power. Neutron detector calibration constants were determined for Spert 3 from flux wire activation data. The cooling system heat balance power calibration was performed in Spert 3 high power transient testing. The fuel rod performance of F-type fuel rods was tested in Spert 4 capsule driver core. Spert 4 dry and water logged F-type fuel rods were failure tested, and the fuel particle size distribution was determined. Insertion effects on Spert 3 peak power during high power transient testing were obtained. NSA

N69-20036 Purdue Univ., Lafayette, Ind.
THE DIFFUSION OF FAST NEUTRONS THROUGH CYLINDRICAL DUCTS IN A SHIELD
Ricardo Artigas (Ph.D. Thesis) 1968 225 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 68-12517

The problem is examined of determining neutron fluxes at the exit of a cylindrical duct in a shield by the use of numerical and stochastic methods. The duct is assumed to have a radius δ and a length l. There is an area source of radius δ and strength N_o, n/sec, at the duct entrance. Up to the present time two methods have been used in solving the problem. The first method approximates the area source by a point source, and an expression for the flux at the center of the duct exit is then found by the use of the albedo concept in one instance and scattering sources in the duct wall, in another instance. The second theoretical approach employs an area source and is based on a solution of the integral transport equation which gives the neutron current, at the exit of the duct. In this thesis both of these methods of solution are examined to determine ranges of validity. Dissert. Abstr.

N69-20043# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
INVESTIGATION OF THE STRUCTURE OF A REACTOR FOLLOWING A NUCLEAR INCIDENT [SULLA SOLLECITAZIONE DELLE STRUTTURE DI UN REATTORE IN SEGUITO AD UN INCIDENTE NUCLEARE]
S. Curioni 1968 32 p refs In ITALIAN
(RT/ING(68)18-PRV-r-(68)15) Avail: CFSTI

The state of the art on the noncontrolled reactions in a nuclear reactor core, and the principle research in this field are critically examined. Attention is concentrated on fast reactors, and some general criteria are projected. A bibliography is included. Transl. by F.O.S.

N69-20047# Argonne National Lab., Ill. Reactor Engineering Div.
A HEAT-PIPE-COOLED FAST-REACTOR SPACE POWER SUPPLY
J. J. Roberts, E. J. Croke, R. P. Carter, and J. E. Norco Jun. 1968 35 p refs
(Contract W-31-109-ENG-38)
(ANL-7422) Avail: CFSTI

A fast-spectrum, nuclear-reactor power supply was designed which compares favorably with radioactive isotope sources and SNAP thermal reactors in the 1 to 5 kW(e) range. The use of a ^{239}Pu-based fuel in a relatively simple design, which employs incore heat pipes and a heat-pipe radiator, yields a comparatively lightweight and low-cost system, which should have good intrinsic reliability. The specific weight for the proposed 1-kW(e) reactor system is about 525 lb/kW(e) (340 lb/kW(e) at 5 kW(e)), as compared to typical weights of about 1000 lb/kW(e) for isotope powered supplies and more than 800 lb/kW(e) for existing SNAP thermal-reactor designs in this power range. Unlike competitive isotopes, ^{239}Pu will be available to meet the anticipated demand for unmanned experimental communication satellites in the 1970's. Moreover, the production cost of this fuel should be approximately 20–70% of the equivalent in isotope power in the 25 to 125 kW(t) power range. Author (NSA)

N69-20062# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
SAVANNAH RIVER LABORATORY ISOTOPIC POWER AND HEAT SOURCES, PART 1: COBALT-60 Quarterly Progress Report, Jul.–Sep. 1968

H. S. Hilborn, comp. Oct. 1968 13 p refs
(Contract AT(07-2)-1)
(DP-1177-I-PT-1) Avail: CFSTI

Acceptable oxidation behavior was shown by Inconel 600, Hastelloy C, and Hastelloy X in accelerated tests that simulated operation at 1000°C for 50,000 hr. Haynes 25 oxidized more than expected. Seventeen capsules containing high activity ^{60}Co wafers were fabricated, and heating tests were begun at 900 and 1000°C in the high level caves. Author (NSA)

N69-20053# Phillips Petroleum Co., Idaho Falls, Idaho.
PHYSICS METHODS USED TO COMPUTE REACTIVITY, PROMPT NEUTRON GENERATION/EFFECTIVE DELAYED NEUTRON FRACTION, AND ROD WORTH FOR THE PBF CRITICAL EXPERIMENTS
B. L. Rushton Oct. 1968 71 p refs
(Contract AT(10-1)-205)
(IDO-17276) Avail: CFSTI

Unusual characteristics of the Power Burst Facility (PBF) that add to the complexity of physics calculations have been mocked up in critical experiments and furnish a means of testing the accuracy of the calculational methods and of the basic cross section data used in the physics design. The techniques used to calculate reactivity, control rod worth, and $\Lambda/\bar{\beta}_{eff}$ for the critical configurations gave generally good results. The results indicate that the calculational techniques should be adequate for PBF design purposes. The calculational techniques and the experimental apparatus are described and comparisons of measurements with calculations are given. Author (NSA)

N69-20060# Argonne National Lab., Ill. Reactor Physics Div.
IN-CORE ACTIVATION TRAVERSES DURING THE PLUTONIUM RECYCLE EXPERIMENT IN THE EXPERIMENTAL BOILING WATER REACTOR AT POWER LEVELS OF 35 TO 70 MW
R. E. Grajek and K. E. Freese Jul. 1968 24 p refs
(Contract W-31-109-ENG-38)
(ANL-7414) Avail: CFSTI

In-core activation traverses during the Plutonium Recycle Experiment in the Experimental Boiling Water Reactor are described. Traverses were made with bare and Cd-covered Al–Mn spheres and also Cu, Au, Ir, and Lu. Power levels of 37, 40, 61, and 70 MW were held during the measurements. Thermal neutron flux distributions are included. NSA

N69-20064 North Carolina State Univ., Raleigh.
AN ON-LINE AUTO- AND CROSS-CORRELATOR FOR NUCLEAR REACTOR NOISE ANALYSIS
William Hutton Sides, Jr. (Ph.D. Thesis) 1968 180 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-13477

An on-line digital auto- and cross-correlator is designed and tested as part of a project which has as its purpose the investigation of the sensitivity of boiling detection methods for nuclear reactors. The correlator is designed to produce the auto- and cross-correlation functions of low frequency signals, *i.e.*, in the range of from 0.05 Hz to 55 Hz. Digital methods are employed to perform the required multiplications and integrations. Tests of the instrument indicate excellent low frequency response and resolution for both auto- and cross-correlation computations. Auto- and cross-correlations of the neutron flux noise on the North Carolina State University Reactor 3 are obtained. Dissert. Abstr.

N69-20068 Michigan Univ., Ann Arbor.
SOLUTIONS OF THE TWO-GROUP TRANSPORT EQUATION IN PLANE GEOMETRY
Dale Robert Metcalf (Ph.D. Thesis) 1968 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-13364

The main objective of this thesis is to obtain exact solutions to the two-group neutron transport equation utilizing the singular eigenfunction approach. By this method exact solutions to a limited set of problems can be obtained against which the accuracy of conventional approximations may be tested. A detailed study was made of the singular eigenfunctions of the two-group transport equation. A convenient linear combination of the continuum eigenfunctions was selected to simplify later analysis. Using these eigenfunctions, a full-range completeness proof for infinite medium applications is presented. For the half-range case, reliance is placed on a half-range theorem proved several years ago and (with this as authority) the general half-range problem is rederived in a form convenient for numerical analysis. Explicitly, two coupled equations are obtained where the unknowns are the discrete and one continuum mode expansion coefficients. Dissert. Abstr.

N69-20141# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
IN-LINE BORON ANALYZER FOR WR-1
R. H. Tuxworth, R. J. Speedy, and R. Matsumoto May 1968 56 p refs
(AECL-3137) Avail: Atomic Energy of Can., Ltd., Chalk River: $1.50

The reactivity of the WR-1 reactor is controlled by the addition of boron as HBO_2 to the heavy water moderator. An autoanalyzer system was installed to measure, intermittently or continuously, the boron concentration by direct sampling from the moderator system. The autoanalyzer uses continuous flow measurement of the color intensity produced by reaction of borate with the reagent H-resorcinol. Details of the total installation and its operation and maintenance are given. Author

N69-20155# Kernforschungszentrum, Karlsruhe (West Germany).
ANALOG COMPUTATION MODEL FOR STEAM-COOLED DIRECT-CYCLE FAST REACTORS
W. Frisch and G. Woite [1968] 60 p refs Transl. into ENGLISH from German Sponsored jointly by US-EURATOM
(KFK-657; EURFNR-496; EUR-3693.d) Avail: CFSTI

An analog computer model is described which was developed to study the dynamics of the D1 steam-cooled fast breeder reactor. The model can also be used to study steam-colled direct-cycle reactors (Loeffler principle or injection steam generator), allowing for the existence of several parallel cycles in the plant. The program simulates dynamic behavior in normal operating conditions and in perturbation conditions. Reactor power, reactivity, fuel temperature, cladding and coolant, and mass flow and pressures are represented as a function of time. NSA

N69-20175# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
COMPARATIVE ANALYSIS OF VARIOUS CYCLES OF COMBUSTION IN A CIRENE TYPE REACTOR [ANALISI COMPARATIVA DI VARI CICLI DI COMBUSTIBILE IN UN REATTORE TIPO CIRENE]
G. Cardosi, A. Mazzanti, and P. Venditti 1968 81 p refs In ITALIAN
(RT/FI(68)39) Avail: CFSTI

The following fuel cycles in heavy water moderated CIRENE type reactors are analyzed from a technical and economical point of view: uranium–thorium cycle, enriched uranium once-through cycle, natural uranium once-through cycle, and uranium–plutonium

cycle. The evaluation for all the cycles is done for a 500 MWe reactor. The comparison between the various cycles is based on a constant set of economic data and a consistent method of analysis. Author

N69-20176*# McDonnell-Douglas Astronautics Co., Richland, Wash. Donald W. Douglas Labs.
THERMAL ABSORPTION IN SEEDED GASES Final Technical Report, 13 Feb. 1968–12 Feb. 1969
J. S. Cory and A. Bennett Feb. 1969 74 p refs
(Contract NASw-1697)
(NASA-CR-100700; DAC-60779) Avail: CFSTI CSCL 18J

To study the concept of radiantly heated seeded aerosol temperatures at which the propellant for a gas-core nuclear reactor would become opaque, hydrogen and helium gasses were seeded with micron-size particles and exposed to radiant energy from a high power (40 kilowatts/cm^2) xenon flash tube. The experimental apparatus consisted of an elliptical reflector which has as its foci the xenon flashlamp and a 6 by 1/2 inch quartz cylinder containing the aerosol. Temperature was determined by measuring the pressure in the constant volume quartz cylinder. Tantalum carbide particles produced the highest temperatures, 5300° and 6600°K for hydrogen and helium respectively. The theoretical model consists of spheres of gas with solid particles at their centers. The model includes reradiation from the particles, heat losses from the gas to the container, temperature dependent values for the heat capacities (seed and gas), and thermal conductivity (seed and gas). Qualitative agreement between this model and the experiment was good, but quantitatively, the theoretical temperatures were too high. Two phenomena were identified as the cause for the disagreement. These were evaporation of the particles, and the chemical reduction of the quartz cylinder inner surface to silicon. Author

N69-20177# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
SPES-1: IBM 7094 PROGRAM FOR THE STUDY OF A NONCONTROLLED, SUDDEN, CRITICAL ACCIDENT IN A FAST REACTOR [SPES-1, PROGRAMMA IBM 7094 PER LO STUDIO DI ESCURSIONI PRONTO-CRITICHE NON CONTROLLATE IN REATTORI VELOCI]
P. Azzoni, A. Carpene, L. DeCecco, P. Poli, and A. Ricci 1968 32 p refs In ITALIAN
(RT/FI(68)45-PRV-r(68)17) Avail: CFSTI

The energy release calculations in an uncontrolled sudden critical accident of a sodium-cooled fast power reactor are studied. A computer code is described which is based on the well known Bethe–Tait method, improved by taking into account the effect of the possible sodium presence in the core channels. This is done because sodium is a very light compressible material whose behavior can be quite different from the behavior of the other core materials. The code, written in FORTRAN IV for a 7094 IBM computer, takes into account the sodium behavior on the basis of an analytical theory, developed for this purpose, which describes the behavior of a cylindrical sodium sample under the action of a radial uniform pressure. The sodium behavior influences the nuclear reaction with regard to the equation of state parameters. Author

N69-20226# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
ANALYSIS OF THE PROPAGATION OF ABSORPTION AND FISSION PERTURBATIONS IN A GRID MULTIPLIER [ANALISI DELLA PROPAGAZIONE DI PERTURBAZIONI DI ASSORBIMENTO E FISSIONE IN UN RETICOLO MOLTIPLICANTE]
A. Musco 1968 31 p refs In ITALIAN
(RT/FI(68)41) Avail: CFSTI

An analysis is made of the propagation of periodical absorption and fission perturbations within a multiplying lattice, placed in the central cavity of the RITMO reactor, for the purpose of determining the optimum position of the detectors used for the oscillation measurements of the central fuel rod. Author

N69-20252# Virginia Univ., Charlottesville. School of Engineering and Applied Science.
FAST NEUTRON SPECTRUM AND DOSE RATE IN WATER AND IN ALUMINUM-WATER LAMINATIONS
G. I. Coulbourn and T. G. Williamson Nov. 1968 53 p refs
(Contract DA-AMC-18-035-90(A))
(AD-680949; NDL-TR-116) Avail: CFSTI CSCL 18/6

The fast neutron spectrum was measured by seven threshold reaction detectors at various distances from a point fission neutron source in water and in two aluminum and water mixtures. The attenuation of the fast neutron dose rate and of the thermal neutron flux was also determined. The experimental results were compared with calculations made with the ANISN computer code. By use of experimentally determined counting efficiencies, absolute saturation activities of the threshold reaction products were determined. A method of neutron spectrum unfolding was devised which represented the fast neutron spectrum by a group of successive exponentials calculated from the saturation activities. The reported spectra generally agreed with the results predicted by the ANISN code. The fast neutron dose rate was measured directly with p-i-n silicon diode dosimeters and indirectly by applying flux-to-dose conversion factors to the measured fast neutron flux. Good agreement was obtained between these measurements and calculations. The saturation activities from the 32S(n,p) reaction were compared with the measured and calculated dose rates and an activity-to-dose-rate conversion factor was estimated. Author (TAB)

N69-20375# RAND Corp., Santa Monica, Calif.
DYNAMIC EFFECTS OF RECYCLE ELEMENTS IN TUBULAR REACTOR SYSTEMS
Guillermo Pareja and M. J. Reilly Dec. 1968 35 p refs
(AD-680745; P-3989) Avail: CFSTI CSCL 7/1

Although tubular reactor-recycle systems frequently contain elements such as mixing tanks or heat exchangers, the effects of material capacitance or heat losses upon the system stability have not been hitherto considered. Methods are presented in this paper for determining the local asymptotic stability of reactor-recycle systems possessing such elements. These methods are applied to two representative systems: one having a mixing tank at the reactor inlet and the other containing a heat exchanger in the recycle line. It is shown that the presence of either of these elements does not have a deleterious effect upon the local stability and may even tend to stabilize the system under appropriate conditions. Author (TAB)

N69-20379# European Atomic Energy Community, Karlsruhe (West Germany). Joint Nuclear Research Center.
MASURCA PLUTONIUM FUEL ELEMENTS FABRICATION
R. Lesser, J. F. Guegnon, M. Maurice and J. Vaane Oct. 1968 307 p refs
(EUR-3663.e) Avail: CFSTI

MASURCA is a fast, critical zero-power assembly. Fuel elements containing 175 kg plutonium were fabricated. Two sorts of plutonium metal were used, containing 8.4% and 3.8% Pu-240 respectively. The elements were required to be 101.6 and 203.2

mm long and have an outer diameter of 12.7 mm. Each element consists of a fine steel can and a core of a plutonium alloy with depleted uranium and a little iron. The original metals were first melted together in a vacuum-induction furnace. The alloy was then cast in rod form in a centrifugal furnace, the rods were machined on a lathe and placed in cans plugged at one end. After decontamination of the open end, insertion of the second plug and welding with an electron beam unit, various inspections were carried out including a leaktightness inspection with a helitest apparatus and a check on the fissile material by spontaneous neutron counting. The finished elements met the specifications. The plutonium losses were about 0.1% of the quantity used. Special attention was paid to work organization and radiation protection.
Author

N69-20402# Naval Research Lab., Washington, D. C.
IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS Quarterly Progress Report, 1 Aug.–31 Oct. 1968
L. E. Steele, C. Z. Serpan, Jr., J. R. Hawthorne, Uldis Potapovs, and Robert A. Gray, Jr. Nov. 1968 48 p refs
(AD-681020; NRL-MR-1937) Avail: CFSTI CSCL 18/10

The report discusses the radiation induced effects of long term operation upon steel plates. The results of three series of experiments are presented as the pre- and post radiation properties of various steels are compared.
TAB

N69-20611# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
ALIZE III: FIRST CRITICAL EXPERIMENT FOR THE FRANCO-GERMAN HIGH FLUX REACTOR. CALCULATIONS [ALIZE III: PREMIERE EXPERIENCE CRITIQUE POUR LE REACTEUR A HAUT FLUX FRANCO-ALLEMAND. CALCULS]
Klaus Scharmer (Ges. für Kernforschung) Jan. 1969 77 p refs In FRENCH; ENGLISH summary
(CEA-R-3393; CEA-R-3393 (E)) Avail: CFSTI

The results of experiments in the light water cooled D_2O reflected critical assembly ALIZE III have been compared to calculations. A diffusion model was used with 3 fast and epithermal groups and two overlapping thermal groups, which leads to good agreement between the calculated and measured power maps, even in the case of strong variations of the neutron spectrum in the core. The difference between the calculated and measured k_{eff} was smaller than 0.5 per cent $\Delta k/k$. Calculations of void and structure material coefficients, reactivity of 'black' rods in the reflector, spectrum variations (Cd-ratio, Pu-U-ratio) and of the delayed photoneutron fraction in the D_2O reflector were made. Measurements of the influence of beam tubes on the reactivity and flux distribution in the reflector were interpreted with regard to an optimum beam tube arrangement for the Franco-German High Flux Reactor.
Author (ESRO)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N69-19667# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
SPECTRAL ANALYSIS BY CORRELATION [ANALYSE SPECTRALE PAR CORRELATION]
Jean-Marc Fauque, Daniel Berthier, Jacques Max, and Georges Bonnet Jan. 1969 69 p refs In FRENCH; ENGLISH summary
(CEA-R-3672) Avail: CFSTI

The spectral density of a signal, which represents its power distribution along the frequency axis, is a function which is of great importance, finding many uses in all fields concerned with the processing of the signal (process identification, vibrational analysis, etc.). Amongst all the possible methods for calculating this function, the correlation method (correlation function calculation and Fourier transformation) is the most promising, mainly because of its simplicity and the results it yields. The study presented in this report will lead to the construction of an apparatus which, coupled with a correlator, will constitute equipment for real-time spectral analysis in the frequency range 0 to 5 MHz.
Author (ESRO)

N69-19716# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
COHERENCE-POLARIZATION PHENOMENA IN REMOTE SENSING
W. G. Egan and H. B. Hallock Mar. 1969 34 p refs Submitted for publication
(RE-358J) Avail: Issuing Activity

The importance of polarization phenomena in remote sensing by electromagnetic means is discussed briefly. With active sensor systems using microwave or laser sources the radiation is very likely to be coherent and plane-polarized. Both intuition and measurement point to anticipated differences in the scattering functions of particles and surfaces interacting with incoherent and with coherent radiation. Polarization is one important aspect of these scattering functions that we have undertaken to investigate in the laboratory. Data selected from our measurements on silica beach sand, Haleakala volcanic ash, and magnesium carbonate have been used to point out significant differences in polarization, depolarization, and photometric functions related to the geometry of incidence and observation. Filtered tungsten light (λ_{eff} = 0.48μ, λ_{eff} = 0.54μ, λ_{eff} = 1.0μ) results are compared with He–Ne laser (0.6328μ) results on the same photometric–polarimetric analyzer, and possible explanations are offered. A very interesting aspect of the magnesium carbonate data is the marked deviation from the cosine law reflection that makes it such a useful photometric reflection standard for incoherent light.
Author

N69-19774# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
NUMERICAL ANALYSIS OF THE FIELD OF THE 2-METRE HYDROGEN BUBBLE CHAMBER MAGNET
N. I. Doinikov, S. N. Komarova, and A. S. Simakov 1968 11 p refs In RUSSIAN
(JINR-P13-4134) Avail: CFSTI

A technique is described for investigating the case of strong iron saturation. The results of the numerical analysis of the stationary field of the 2-meter hydrogen bubble chamber magnet obtained in the plane-parallel approximation by the net-point method using a BESM–3M computer, are given.
Author (NSA)

N69-19942 Michigan Univ., Ann Arbor.
AN INVESTIGATION OF THE BEHAVIOR OF THE ACOUSTIC EMISSION FROM METALS AND A PROPOSED MECHANISM FOR ITS GENERATION
Anand Behari Lal Agarwal (Ph.D. Thesis) 1968 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-13270

Specimens of 99.99 percent purity aluminium, 1020 steel, 2024 aluminium, and Alcoa 195 aluminum were loaded in uniaxial tension using a piezoelectric crystal transducer as a detector in conjunction with an amplifying system in order to record the

amplitude and the number of generated acoustic pulses as a function of the induced stress. The effect of microstructural variations through controlled heat treatment of the specimens on the emission behavior was studied. Substantial emission during loading was detected from 99.99 percent purity aluminum and from solution-treated 2024 and Alcoa 195 aluminum alloys, only upon the first application of load. No significant load emission could be detected from materials in cold-worked condition. Precipitation hardening of 2024 aluminum causes load emission activity to decrease. Overaging, however, tends to cause it to return. These results indicate that the load emission may be due to the activation of Frank-Read sources of a certain minimum size. For the detection system used, the minimum loop length of the source that can be detected has been estimated to be of the order of 10^{-4} cm. Cumulative unload emission count was found to depend upon the maximum stress reached, the volume of the stressed material, and the hardness. It appears to be independent of the surface are and surface finish. Dissert. Abstr.

N69-19977 Purdue Univ., Lafayette, Ind.
ACOUSTIC MEASUREMENTS AND CONVECTIVE EFFECTS ON MICROWAVE BREAKDOWN IN LOW PRESSURE GASES
Aswini Kumar Mohanty (Ph.D. Thesis) 1968 200 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-12589

Theoretical analysis indicated that convective loss of electrons due to bulk motion equals their diffusive loss when $\bar{u} \approx 2D/\Lambda$. Turbulent diffusion is comparable to molecular diffusion when $\varepsilon \approx D$. Breakdown power measurements indicated that the power necessary to maintain ionization increases with gas flow up to a certain limit and then remains insensitive to further small changes in velocity. Measurements of resonant sound pressure levels in low pressure air, nitrogen and argon were conducted. The results of acoustic studies for those of the breakdown in presence of convection were for use in investigating the effects of a resonant sound field on the turbulent transport of charged particles. The acoustic measurements indicated that the attenuation of a sound pressure signal in a microphone probe depends upon the type of the gas, gas pressure, sound pressure level and the signal frequency. Attenuation is higher in a medium with high characteristic impedance. At low pressures (required for ionization by a microwave field) the attainable sound pressure level was less than that required for flow-acoustic interaction. The effect of a resonant sound field on the microwave breakdown was investigated. The sound field did not have measurable effects on the pulsed microwave breakdown power, but pressure fluctuation of acoustic nature due to pulsed breakdown was observed in the ionized gas, which was attributed to the periodic temperature change of the gas column in the neighborhood of 2°F by absorption of energy from the microwave field. The amplitude of this sound pressure was approximately equal to that attainable by a 30 W electromechanical driver at low gas pressures. Use of a pulsed discharge is suggested as a high intensity sound source at low ambient pressures. Dissert. Abstr.

N69-19987 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
OPTICAL AND INFRARED SPECTROSCOPY
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 37–45 (See N69-19981 09-34)
(Contract DA-28-043-AMC-12536(E))
Avail: CFSTI

Many of the interactions of electromagnetic radiation with matter can be expressed most concisely in terms of a linear dielectric response function. Consequently, when studying the properties of a solid by means of its interaction with electromagnetic radiation, it is instructive to delimit the applicability of the dielectric response function by deriving it. Such a procedure will show that it can be applied to the processes of reflection, transmission, absorption, and elastic scattering of electromagnetic radiation, but cannot be applied directly to those processes in which the frequency of the scattered radiation differs from that of the incident radiation, as in Raman scattering. Moreover, by considering it to be an analytic function the following derivation makes explicit the characteristic parameters of the dielectric response function, which can be completely specified by a scaling coefficient and the locations of all of its poles and zeros in the complex frequency domain. Finally, upper and lower bounds can be placed on the estimates of the characteristic frequencies based upon experimentally determined values. Author

N69-19990 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
PHYSICAL ACOUSTICS
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 53–54 refs (See N69-19981 09-34)
(Contracts N00014-67-A-0204-0019; DA-28-043-AMC-02536(E))
Avail: CFSTI

An apparatus for obtaining sonic velocities by means of accurate diffraction angle measurements has been checked out by measurements on highly perfect crystalline quartz; the results were within 0.1% of elsewhere reported values. Author

N69-20050 Minnesota Univ., Minneapolis.
OPTICAL CONSTANTS OF CRYSTALS AND AQUEOUS SOLUTIONS BY ATR TECHNIQUES
Roger Edward Frech (Ph.D. Thesis) 1968 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-12300

Optical constants, the index of refraction and the absorption coefficient of various condensed phases were measured by the method of attenuated total reflection, which consists of measuring the reflectivity of light incident on a sample through a high index of refraction material. For angles of incidence above the critical angle total reflection occurs, and the sensitivity of the reflectivities to the optical constants of the sample is greatly enhanced. The first condensed phase system studied was a single crystal of sodium bromate, $NaBrO_3$. Experimental anomalies led to the rejection of the conventional two layer model and the existence of an air gap between sample and high index material was postulated. An expression for the reflectivity of this three layer model was obtained and it was ascertained that this model could at least qualitatively account for the observed anomalies. For aqueous systems, the optical constants of pure liquid water were obtained from 4000 cm^{-1}. There were three absorption bands resolved in the O–H stretching region. Certain absorption bands of anions in water were also measured. The effect of ions on water was observed by measuring the O–H stretching region of a 4.51 M solution of calcium chloride, a 4.46 M solution of calcium bromide, and a 4.48 M solution of calcium iodide. The H–O–H bend of the iodide solution was also measured. Dissert. Abstr.

N69-20080 California Inst. of Tech., Bishop.
ELECTROMAGNETIC SCATTERING FROM CYLINDRICALLY AND SPHERICALLY STRATIFIED BODIES
Raymond Walter Latham (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-12748

A method is developed for calculating the electromagnetic field scattered by certain types of bodies. The bodies consist of inhomogeneous media whose constitutive parameters vary only with the distance from some axis or point of symmetry. The method

consists in an extension of the invariant imbedding method for treating wave problems. This method, which is familiar in the case of a one-dimensional inhomogeneity, is extended to handle special types of two and three-dimensional inhomogeneities. Comparisons are made with other methods which have been proposed for treating these kinds of problems. Examples of applications of the method are given, some of which are of interest in themselves. Dissert. Abstr.

N69-20081 California Univ., Los Angeles.
ANALYSIS OF NONLINEAR TRANSMISSION LINE EQUATIONS
Jack Leonard Gaston (Ph.D. Thesis) 1968 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-12466

This paper presents some methods for the approximate solution of the equations of electrical transmission lines with nonlinear distributed parameters. A perturbation solution and detailed calculations are given for a line with nonlinear conductance $g_0 + g_2v^2$, where $g_2v^2 << v$, and a steady-state sinusoidal voltage input. Additional uses of the perturbation method are outlined. An approximate solution is given for a step function voltage input applied to a low-loss line with nonlinear conductance $g_0 + g_2v^2$. An approximate solution is given for trapezoidal or triangular voltage inputs applied to a low-loss line with capacitance $c_0 - c_2v^2$, where $c_2v^2 << c_0$, and where shock waves do not form. Dissert. Abstr.

N69-20083 Arizona Univ., Tucson.
WAVE PROPAGATION IN INHOMOGENEOUS ANISOTROPIC MEDIA
John Richard Schulenberger (Ph.D. Thesis) 1968 175 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-12923

In the present paper the existence of a Green's matrix Γ for an operator M governing wave propagation in inhomogeneous, anisotropic media is demonstrated by treating M as a perturbation of the operator M_0 describing wave motion in uniformly propagative media. It is hereby assumed that the homogeneous medium has only non-zero propagation speeds and that the inhomogeneity is confined to a bounded subset of R^n. It is shown that the Green's matrix Γ delivers a (weak) solution $u = \Gamma(g)$ of the differential system $Mu = g$, where g is a bounded, measurable (vector-valued) function on R^n with compact support which describes the sources acting in the medium. This solution u is further shown to be unique among all functions of a class R consisting of admissible "radiation" functions. Dissert. Abstr.

N69-20115# Joint Publications Research Service, Washington, D. C.
MARINE ACOUSTICS
Yu. Tarasyuk 20 Feb. 1969 4 p Transl. into ENGLISH from Morsk. Flot (Moscow), no. 12, 1968 p 37–38
(JPRS-47496) Avail: CFSTI

A critical review is presented on the book which is directed to the needs of oceanologists, hydrologists, hydrometeorologists, and specialists on the shipping and fishing fleet, in addition to specialists in hydroacoustics. The sea as a sound-conducting medium is described, and recommendations are made on computations of the effective range and best values of various parameters of hydroacoustic instruments. Consideration is also given to the fundamental equations and methods for determining the acoustic field; the characteristics of sound propagation from explosive sources; the reasons for and character of hydroacoustic noise and interference; and experimental data on the acoustic and physical properties of water and the sea floor. A statistical approach is used in describing reverberation. Author

N69-20119 Washington Univ., Seattle.
CONSTRUCTION OF ALMOST SURELY CONVERGENT RANDOM PROCESSES
David Harley Root (Ph.D. Thesis) 1968 51 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-12713

Various sequences of random walks converge weakly to Brownian motion. Representations are constructed of processes in which weak convergence is strengthened to almost sure uniform convergence of the sample paths. The first construction of almost surely convergent random walks depends upon the existence of certain stopping times. Convergent random walks can be constructed if the appropriate stopping times can be found and if the stopping time possesses a finite fourth moment. Equivalent processes are constructed so that their sample paths converge to the sample paths of Brownian motion. This implies weak convergence. A consequence of this construction is that the empirical processes can be represented in such a way that their sample paths will converge almost surely to those of the Brownian bridge in the uniform metric. Dissert. Abstr.

N69-20142# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
VOLTAGE AND CURRENT CENTERING OF AN ELECTRON MICROSCOPE OBJECTIVE LENS
R. A. Ploc Dec. 1968 32 p refs
(AECL-3225) Avail: Atomic Energy of Can., Ltd., Chalk River. $1.00

An attempt was made to determine the method of aligning an electron beam relative to a non-ideal objective lens of an electron microscope which allows the attainment of maximum resolution. A simplified Gaussian optical treatment indicated that under normal conditions maximum resolution is achieved when the electron beam passes along the voltage axis of the lens. The presence of current and voltage axes was due to the non-ideal nature of the lens and to the presence of a combination of lenses respectively. Author

N69-20179# Washington State Univ., Pullman. Shock Dynamics Lab.
SHOCK WAVE PROPAGATION IN A DISSIPATING LATTICE MODEL
Ramachandra N. R. Manvi (Ph.D. Thesis) Jun. 1968 165 p refs
(Contract AF-AFOSR-1088-66)
(AD-680812; WSU-SDL-68-04; AFOSR-68-1673) Avail: CFSTI CSCL 20/11

A model for one dimensional shock wave propagation is studied. The model consists of a semi-infinite chain of particles with nonlinear nearest neighbor interaction. The nonlinear force law for springs considered in the study is of parabolic and Morse type. The viscosity is introduced for dissipation by means of a mechanical dashpot in parallel with the spring. The resulting differential-difference equation of motion is numerically integrated by an iterative scheme on the IBM 360/67 computer. The object of the study is to show the analogy between the lattice model and the continuum for shock wave propagation. It is found that viscosity as introduced in the model plays an important role in the structure and propagation mode of the shock wave. An attempt is also made for the analytic solution of the nonlinear differential-difference equation of motion under reasonable simplifications as a check on the computer solution and for better understanding of the physics of the problem. TAB

N69-20198# National Bureau of Standards, Boulder, Colo. Radio Standards Physics Div.
INTERFEROMETRIC MEASUREMENTS OF THE COMPLEX DIELECTRIC CONSTANT OF LIQUIDS
W. S. Lovell and L. M. Thiel Aug. 1968 91 p refs
(NBS-TN-369) Avail: SOD $0.50

A series of articles describe the research results on interferometric measurements of the complex dielectric constant of liquids. Errors arising from the use of a perfect square approximation in treating free space, interferometric measurements of the complex dielectric constant $\epsilon^* \equiv \epsilon' - i\epsilon''$ of liquids are described. It is shown that such errors (1) are generally positive, (2) often exceed values previously estimated for the measurement technique as a whole, and (3) are not generally predictable without some prior knowledge of the dielectric properties of the material being investigated. Design details, operation, and error analysis of a free space, millimeter wave interferometer are described. The apparatus radiates at oblique incidence to an air–dielectric–metal configuration placed between dissimilar horns. A theoretical reflection coefficient for the air–dielectric–metal configuration is derived. The derivation is based on a model which treats multiple reflections within the dielectric explicitly. A numerical method is presented for determining the best complex dielectric constant $\epsilon^* \equiv \epsilon' - i\epsilon''$ from an experimental record obtained at millimeter wavelengths for free space, interferometric measurements of liquids. B.P.

N69-20206# Stanford Univ., Calif. Stanford Electronics Labs.
WAVE PROPAGATION IN A RANDOM MEDIUM
Robert W. Lee and Jeffrey C. Harp Jun. 1968 109 p refs
(Contract F19628-68-C-0055)
(AD-681176; SU-SEL-68-066; AFCRL-68-0343; SR-1) Avail: CFSTI CSCL 20/14

A simple technique has been used to derive statistical characterizations of the perturbations imposed upon a wave (plane, spherical or beamed) propagating through a random medium. The method is essentially physical rather than mathematical, and is probably equivalent to the Rytov method. The limitations of the method are discussed in some detail; in general they are restrictive only for optical paths longer than a few hundred meters, and for paths at the lower microwave frequencies. Situations treated include arbitrary path geometries, finite transmitting and receiving apertures, and anisotropic media. Results include, in addition to the usual statistical quantities, time-lagged functions, mixed functions involving amplitude and phase fluctuations, angle-of-arrival covariances, frequency covariances, and other higher-order quantities. Author (TAB)

N69-20305# Stanford Univ., Calif. Dept. of Applied Mechanics.
WAVE FRONT IN COMPOSITE MATERIALS
T. C. T. Ting and E. H. Lee Dec. 1968 43 p refs Sponsored in part by ARPA
(Contract DA-04-200-AMC-6590X)
(AD-680808; TR-193; Rept-15) Avail: CFSTI CSCL 20/11

The propagation of an initially sharp plane pressure pulse through a linear elastic composite medium is analyzed. Wave front and ray theory analogous to geometrical optics is shown to determine the change in shape of the leading wave front and also the stresses immediately behind it. For certain circumstances the stress amplitudes on this front, or the corresponding tensile stresses on its reflection at the free back surface of a slab, may be critical in design. Examples are presented of an initially sharp plane pressure pulse transmitted through an elastic circular cylinder and an elastic spherical inclusion. The method can be applied to more general composite configurations, and can be extended to determine the stress gradient behind the front. For the latter, general formulae are derived by which the reflection and transmission coefficients can be determined for the stress gradient and the higher order derivatives at an arbitrary interface. Author (TAB)

N69-20355# Pennsylvania State Univ., University Park. Materials Research Lab.
INFRARED TRANSMITTING MATERIALS Semiannual Technical Report, 1 Jun.–30 Nov. 1968
William B. White Dec. 1968 29 p refs
(Contract N00014-67-A-0385-0005)
(AD-681083; SATR-1) Avail: CFSTI CSCL 20/6

The report deals with the infrared transmitting properties of fluorite structure oxides and the heavy metal covalent oxides of bismuth and lead. Transmission data for single crystal ThO_2 are given. A theoretical analysis of the vibrational modes, selection rules and IR spectra of the powders are given for alpha-Bi_2O_3, $PbO.6Bi_2O_3$, tetragonal PbO, orthorhombic PbO, and Sr_2PbO_4. Author (TAB)

N69-20394# National Bureau of Standards, Boulder, Colo. Radio Standards Physics Div.
SOLUTION OF THE ABEL INTEGRAL TRANSFORM FOR A CYLINDRICAL LUMINOUS REGION WITH OPTICAL DISTORTIONS AT ITS BOUNDARY
Earl R. Mosberg, Jr. and Matthew S. Lojko 12 Jul. 1968 29 p refs
(NBS-TN-368) Avail: SOD $0.25

The use of orthogonal polynomial expansions in the calculation of the Abel integral transform is discussed. Particular attention is directed to the effects of optical and instrumental distortions when the luminous region is contained by a cylindrical glass tube. An easily calculable solution of the Abel integral is presented which reduces the effect of such distortions by employing a weighting function which has a maximum at the center and vanishes at the boundary. This approach results in a more accurate solution of the Abel integral transform in the case where significant optical and instrumental distortions are present near the boundary of the luminous region. Author

N69-20419# National Academy of Sciences—National Research Council, Washington, D. C. Advisory Committee to the Air Force Systems Command.
SYNTHETIC-APERTURE OPTICS. VOLUME 1: WOODS HOLE SUMMER STUDY, AUGUST 1967
[1968] 95 p refs
(Contract F18600-67-C-0071)
(AD-680606) Avail: CFSTI CSCL 20/6

The purpose of the present study is to consider the feasibility of increasing optical resolution by what may be termed synthetic-aperture optics. This term is defined here in a very broad sense to include any technique for achieving, with one or more small apertures, the resolution normally associated with a single large aperture. To date, the largest body of experience with aperture synthesis has been in the microwave region of the spectrum, where synthetic-aperture radars and radio-astronomy telescope arrays have been used for a number of years. It should be emphasized that the field of synthetic-aperture optics is very new and relatively unexplored. Volume 1 contains a connected account of the results of the summer study and employs a minimum of mathematics. The various approaches to optical aperture synthesis have been divided into six classes, as follows: Interferometry; Feedback-controlled optics; Imaging with partially filled apertures; Aperture synthesis with coherent illumination; Object restoration beyond the diffraction limit; and Miscellaneous aperture synthesis techniques. Author (TAB)

N69-20500# Raytheon Co., Bedford, Mass. Missile Systems Div.
ACOUSTIC RECEPTION AND FLOW NOISE CONTROL OF MOVING PIPE SENSORS Final Report

G. Y. Chin Dec. 1968 108 p refs
(Contract N00014-68-C-0244)
(AD-681084; BR-5089) Avail: CFSTI CSCL 20/1

Calculations are made for the reception properties, flow noise and equivalent flow noise of a porous pipe receiver for a range of frequencies, angles, Mach numbers, and pipe lengths. The flow noise calculations are made assuming a homogeneous turbulent boundary layer-calculations for the sea water medium are also made. Similar calculations are made for a pipe receiver having discrete holes (air medium) in finer details than that previously made in our earlier study. Experimental measurements of the directional properties of the porous pipe receiver, together with flow noise measurements made on a glider in flight, are presented - measurements compare reasonably with theoretical results. Measurements show low flow noise levels - lower than previously measured in wind tunnels and in drops from airplane. Calculated also are directivity functions of speed-tuned simple line receivers.
Author (TAB)

N69-20508# Rome Air Development Center, Griffiss AFB, N. Y.
AMPLITUDE SCINTILLATION STUDY
Raymond P. Urtz, Jr., Donald O. Tarzano, and Ronald E. Gleba Dec. 1968 109 p refs
(AD-681142; RADC-TR-68-416-VOL-1) Avail: CFSTI CSCL 20/6

The presence of the atmosphere acts to degrade the transmission of optical signals. Natural turbulence in the atmosphere induces amplitude fluctuations on a propagated optical signal. This report describes an experimental program conducted to determine the characteristics of amplitude scintillation. The study was aimed at defining the degree of scintillation incurred and the associated frequency spectrum for a source immersed in the atmosphere. Correlation studies were also undertaken to relate the scintillation characteristics to the meteorological parameters of the troposphere. The report briefly summarizes available knowledge of scintillation and then describes the program in detail. Information is given on the characteristics of the measurement system, flight test procedures, and meteorological instrumentation. Data reduction procedures and interpretation of results will be presented in Volume II.
Author (TAB)

N69-20510*# National Aeronautics and Space Administration, Washington, D. C.
NOISE MEASUREMENT PERFORMED ON BODIES IN A FLOW IN SUBSONIC WIND TUNNELS, PART 1 [UEBER DIE GERAUSCHMESSUNG AN UMSTROMTEN KORPERN IN UNTERSCHALLWINDKANALEN, TEIL 1]
G. Schulz Mar. 1969 35 p refs Transl. into ENGLISH from German Report DLR-FB-68-43
(NASA-TT-F-1211; DLR-68-43) Avail: CFSTI CSCL 20A

The systematic investigation of noise generated by bodies in a flow is a task for wind tunnels. Wind tunnels produce too much intrinsic noise when constructed in the normal manner. The self-generated noise comes predominantly from the fan. Furthermore, wind tunnel tests sometimes show aero-acoustic feedback effects between the tunnel and the model. Suggestions for avoiding these defects are given.
Author

N69-20588# Navy Underwater Sound Lab., New London, Conn.
AN EVALUATION OF A SIGNAL DISTORTION INTEGRAL
David H. Wood Oct. 1968 18 p refs
(AD-681013; USL-955) Avail: CFSTI CSCL 20/1

Using formal methods, R. R. Goodman has given an integral representation of the response due to an arbitrary signal from a point source in a constant gradient medium. A generalization of this integral, valid for L squared signals, is evaluated by showing that the Fourier transform of e to the power (-i omega tau the square root of (1-K squared omega squared)) minus e to the power (-1 omega) is -2 pi K tau H(t-tau) J sub 1 (K(the square root of (t squared - tau squared)/the square root of (t squared - tau squared), where H is the unit step function. The final result is expanded in a series that converges rapidly for small gradients (small K).
Author (TAB)

N69-20606# Michigan Univ., Ann Arbor. Radiation Lab.
ELECTROMAGNETIC SCATTERING FROM CERTAIN RADIALLY INHOMOGENEOUS DIELECTRICS Interim Scientific Report
Nicolaos Georgiou Alexopoulos (Ph.D. Thesis) Nov. 1968 112 p refs
(Contract F19628-68-C-0071)
(AD-681125; Rept-1363-3-T; SR-3; AFCRL-68-0617) Avail: CFSTI CSCL 20/14

The phenomenon of electromagnetic wave propagation through, and scattering from, radially inhomogeneous dielectrics is studied for very high frequencies. The dielectrics are considered lossless, radially inhomogeneous in the spherical coordinates system, and of the converging or of the diverging type. The lens problem is studied by the geometrical optics technique and the radar cross-section of perfectly conducting spheres coated with radially inhomogeneous dielectrics is investigated. By assuming a plane wave as the incident electromagnetic field, the contribution in the backscattering direction due to the reflected field and the creeping waves is determined by applying asymptotic theory. This necessitates the use of the WKB and/or Langers method for the solution of the pertinent differential equations, depending on whether there exist transition points in the range for which the solutions are required. Also, the integrals of Scott are needed in order to determine the reflected portion of the field. Such a study is interesting not only from the theoretical but also from the practical point of view, in that it lends itself useful to the understanding of radio wave propagation in radially inhomogeneous dielectrics and of the effect of coating perfectly conducting spheres with radially inhomogeneous media. It also has applications to problems of wave propagation in the ionosphere and around the earth.
Author (TAB)

N69-20609# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
MAGNETIC STUDY OF A FEW ANTIFERROMAGNETS IN VERY STRONG PULSED FIELDS (450 kOE) [ETUDE MAGNETIQUE DE QUELQUES ANTIFERROMAGNETI QUES DANS DES CHAMPS PULSES TRES INTENSES (450 kOE)]
Jean-Pierre Krebs (Ph.D. Thesis—Paris Univ.) Jul. 1968 158 p refs In FRENCH; ENGLISH summary
(CEA-R-3495) Avail: CFSTI

A pulsed field device for determining magnetization curves up to 450 kOE at temperatures between 1.6°K and 300°K is described. The 'spin-flopping' (and therefore the anisotropy) in MnF_2 versus temperature, below the Neel point is described along with the antiferromagnets $MnSO_4$ and $MnSO_4.H_2O$ which have revealed saturation fields of 250 kOE and 320 kOE respectively.
Author (ESRO)

N69-20621# Commissariat à l'Energie Atomique, Bruyères-le-Châtel (France).
STATIC ELECTRICITY: FORMATION, DETECTION, MEASUREMENT AND SAFETY IN WORKSHOPS [ELECTRICITE STATIQUE: FORMATION, DETECTION, MESURE ET PREVENTION DANS LES ATELIERS]
Elisee Moulet Jan. 1969 35 p refs In FRENCH; ENGLISH summary
(CEA-BIB-139) Avail: CFSTI

This literature survey is a selection of references concerning static electricity (formation, detection, measurement and safety in workshops). The period covered goes from 1938 to 1968 inclusive. The survey contains 6 indexes : authors, subjects, periodicals, books and report initials - 171 references. Author (ESRO)

N69-20644# George Washington Univ., Washington, D. C. Dept. of Physics.
ULTRASONIC REFLECTIVITY AT A LIQUID-SOLID INTERFACE AT THE RAYLEIGH ANGLE
Orest I. Diachok Jan. 1969 64 p refs
(Contract Nonr-5037(01))
(AD-681368; TR-4) Avail: CFSTI CSCL 20/1

When a bounded ultrasonic beam is reflected from a liquid-solid interface the measured reflectivity is found to be in disagreement with the theoretically predicted reflectivity when the angle of ultrasonic incidence is at or near the Rayleigh angle. Some possible mechaniams which would explain this discrepancy are investigated. It is shown that the magnitude of the effect and the frequency range in which it occurs is not a function of the liquid. It is shown that at the Rayleigh angle the incident beam is partly reflected and partly reradiated nearly isotropically into the liquid. Author (TAB)

N69-20687# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF AEROSOL OPTICAL PROPERTIES
S. D. Tvorogov Jan. 1968 6 p refs Transl. into ENGLISH from Tr. Akad. Nauk Kazakhsk. SSR, Astrofiz. Inst. (Alma-Ata), v. 3, 1962 p 105–107
(AD-680773; FTD-HT-23-1250-67) Avail: CFSTI CSCL 20/6

Formulas were obtained for calculating the optical properties of aerosols. These formulas reduce considerably the computation work required in conventional methods of numerical integration. The deduction of the formulas was based on the assumption that the density of the size distribution function follows the normal logarithmic law. Author (TAB)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N69-19601*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ELECTRON MOBILITY IN RANDOMLY LOCATED HARD-CORE SCATTERERS
Harold E. Neustadter (Ph.D. Thesis—Case Western Reserve Univ.) Jun. 1969 105 p refs
(NASA-TM-X-52569) Avail: CFSTI CSCL 20J

Kubo's formulation of irreversible quantum statistics is applied to electron mobility. In the weak coupling limit the approach to equilibrium is shown to be characterized, in the lowest order, by a relaxation time. With the use of wave functions for hard-core interactions a characteristic relaxation time is derived which to "all orders" is independent of the external (small) driving force. For the specific application to mobility the general theory yields the known results of semi-classical kinetic theory at high temperature and low density. For the region of lower temperature and higher density the theory gives qualitative agreement with the anomalous drop in mobility found for electrons in low temperature helium. However, lack of quantitative agreement indicates a need for further work on the problem. Author

N69-19625# Kyoto Univ. (Japan). Research Reactor Inst.
THE FAST NEUTRON FLUX MEASUREMENT USING THE Rh SUP 103 (n,n) Rh SUB 103m REACTION
Itsuro Kimura and Katsuhei Kobayashi 1967 13 p refs In JAPANESE; ENGLISH summary
(KURRI-TR-42) Avail: CFSTI

The energy-dependent cross section for the $^{103}Rh(n,n')^{103m}Rh$ was carefully measured. Monoenergetic neutrons were produced with a 2-MeV Van de Graaff accelerator. A thin NaI(Tl) scintillator with a beryllium window was used to measure the relative activity of ^{103m}Rh. For the absolute measurement, a standard ^{103m}Rh source was made from ruthenium trichloride irradiated with thermal neutrons. In this case, the electrodeposition technique was introduced. Although the cross-section curve for the $^{103}Rh(n,n')^{103m}Rh$ reaction shown by Beauge has a resonant peak around 600 keV, the present result shows no peak and seems close to the Vogt and Cross data. And the fission-spectrum-averaged cross section for the reaction was found to be 558 ± 32 mb. The reaction was applied in practice to fast neutron flux measurement at the Kyoto University Reactor. The result agrees closely with the theoretical calculation and shows the effective cross section obtained to be reasonable. Finally, the advantage of using the $^{103}Rh(n,n')^{103m}Rh$ reaction as a fast neutron radiation damage monitor is discussed. NSA

N69-19627# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
A MEASUREMENT OF GAMMA FOR THE 132EV CO-59 RESONANCE
T. Wall Jul. 1968 13 p refs
(AAEC/TM-466) Avail: CFSTI

The radiative width for the 132-eV resonance in ^{59}Co was determined using an activation technique. The value of 0.48 ± 0.04 eV obtained leads to acceptable calculated values for the thermal cross section and resonance integral of ^{59}Co. The usefulness of ^{59}Co as a neutron flux detector in nonthermalized spectra is also discussed. Author (NSA)

N69-19636# Kyoto Univ. (Japan). Research Reactor Inst.
ON THE ABSOLUTE MEASUREMENTS OF THERMAL NEUTRON FLUX
Tsutomu Nanjyo [1968] 18 p refs In JAPANESE; ENGLISH summary
(KURRI-TR-45) Avail: CFSTI

A method of measuring the absolute thermal neutron fluxes in slowing-down media is described. The concept of the thermal neutron spectrum and the definition of the thermal neutron flux are reviewed. The thermal neutron flux is defined by the Maxwellian component of the slow neutron flux. The slow neutron spectra and the associated indices were calculated for several borated light water media using Nelkin's scattering kernel. In the present method, the unknown neutron spectrum is estimated by the comparison of the experimentally obtained cadmium ratio and the calculated ratio. The nuclear characteristics of gold are listed, and the problems of neutron absorption by probes, both bare and cadmium-covered, are treated. The β-γ coincidence counting technique for ^{198}Au is mentioned. Author (NSA)

N69-19658# International Centre for Theoretical Physics, Trieste (Italy).
NONLINEAR REALIZATIONS. PART 2: CONFORMAL SYMMETRY

Abdus Salam and J. Strathdee Dec. 1968 27 p refs Submitted for publication
(IC/68/107) Avail: CFSTI

Use is made of the formalism of non-linear realizations to treat the spontaneous violation of conformal symmetry. The associated 'Goldstone' particles, which are characterized by a 4-vector and a scalar field, are unusual in that they possess mass. Author (ESRO)

N69-19659# International Centre for Theoretical Physics, Trieste (Italy).
ON THE PARAMETRIZATION OF PION NUCLEON SCATTERING AMPLITUDE AT ENERGIES LESS THAN 2 GeV
A. Y. Abul-Magd and G. Alberi (Trieste Univ.) Nov. 1968 19 p refs Submitted for publication
(IC-68-102) Avail: CFSTI

The pion-nucleon elastic scattering amplitude is parametrized as a function of the momentum transfer for $\cos\theta_{cm}$ between 1.0 and 0.5 and for laboratory pion energies less than 2 GeV. The variation of the parameters with the incident energy is discussed. ESRO

N69-19661# International Centre for Theoretical Physics, Trieste (Italy).
FINITE AND INFINITE COMPONENT FIELDS AND EQUATIONS GENERATED FROM THE DIRAC EQUATION
C. D. Palev Jul. 1968 24 p refs Submitted for publication
(IC-68-71) Avail: CFSTI

A method is presented which allows one to regard classes of finite and infinite component wave equations from a unique point of view. The equations of a given class appear as different forms of one generalized equation. With the help of a well defined automorphism the equations may be obtained from one another. In this way it is possible to generate a set of finite as well as infinite component equations from a given one. An example is given with the Dirac equation. Author (ESRO)

N69-19671# Commissariat à l'Energie Atomique, Limeil (France).
LINKED INTRINSIC STATES OF NUCLEONS IN HIGHLY DEFORMED NUCLEI: SUPPLEMENT TO NILSSON'S MODEL [ETATS LIES INTRINSEQUES DES NUCLEONS DANS LES NOYAUX FORTEMENTS DEFORMES: SUPPLEMENT AU MODELE DE NILSSON]
Jacqueline Houviez (Ph.D. Thesis--Paris Univ.) Dec. 1968 93 p refs In FRENCH; ENGLISH summary
(CEA-R-3645) Avail: CFSTI

A program for the energies and components of nucleonic intrinsic states using Nilsson's model of deformed nuclei is established. The shell contributions of different N, are introduced for the first time. Consequently, N is no longer a good quantum number and the eigen states obtained by this method are linear combinations of states of different N, whereas Nilsson's states have a fixed value of N. An approach to the evaluation of the importance of these non-diagonal terms arising from quadrupolar deformations is made. Finally these results are applied to a comparative study of the intrinsic states and magnetic moments of some transuranic nuclei using Nilsson's model and the modified Nilsson model. Author (ESRO)

N69-19673# International Centre for Theoretical Physics, Trieste (Italy).
NON-INVARIANCE OF A BETHE-SALPETER EQUATION
C. Fronsdal and Y. C. Yang (California Univ.) Jul. 1968 9 p refs Submitted for publication
(IC-68-70) Avail: CFSTI

The well-known result of Cutkosky concerning an accidental O(4) symmetry of the Bethe-Salpeter equation for two equal-mass particles interacting through the exchange of a scalar photon has been re-examined. It turns out that the theory is not O(4) invariant and that the fine structure does not vanish. Author (ESRO)

N69-19674# International Centre for Theoretical Physics, Trieste (Italy)
ON THE RADIATIVE CORRECTIONS TO THE ELECTROMAGNETIC PROPERTIES OF HADRONS
Z. Z. Aydin and A. O. Barut Nov. 1968 13 p refs Submitted for publication
(IC-68-101) Avail: CFSTI

It is shown that for particles with an anomalous magnetic moment the radiative corrections cannot be consistently treated by the perturbation theory using a non-minimal coupling. The internal structure of the particle that is responsible for the form factors must be explicitly considered. In the relativistic composite particle model which correctly describes the complete form factors, the radiative corrections are automatically included if the current operator is suitably chosen. Author (ESRO)

N69-19675# International Centre for Theoretical Physics, Trieste (Italy).
ON THE DYNAMICS OF REGGE TRAJECTORIES
N. G. Antoniou Nov. 1968 9 p refs Submitted for publication Prepared jointly with Athens Univ.
(IC-68-103) Avail: CFSTI

The restrictions imposed by analyticity on the widths of the low-energy resonances lying on linear Regge trajectories are discussed in a specific model. In particular, the case of the ρ-trajectory is discussed within this model. Author (ESRO)

N69-19692# International Centre for Theoretical Physics, Trieste (Italy).
CALCULATION OF THE K_{l3}
A. O. Barut and K. C. Tripathy (Syracuse Univ.) Oct. 1968 21 p refs Submitted for publication Sponsored in part by the U.S. AEC
(IC-68-97) Avail: CFSTI

The K_{l3} form factors have been determined in a model of strong interactions based on the rest frame group O(4,2) $\otimes$ SU(3). Using the values of the parameters determined from the boson mass spectrum and the pion electromagnetic form factor, we obtain at $t = t_0$ $tO = (m_K - m_\pi)^2$, a ratio of the form factors of 0.27 is obtained. The SU(3) symmetry condition at 0 yields $\lambda_+ = 0.0152$, $\lambda_- = 0.199$, and $\Xi(0) = 0.097$, in agreement with latest experimental values. ESRO

N69-19702# International Centre for Theoretical Physics, Trieste (Italy).
SIMPLY TRANSITIVE SUBGROUPS G_4 OF THE POINCARE GROUP: A NEW FINDING IN THE SPECIAL THEORY OF RELATIVITY
E.J. Schremp Sep. 1968 35 p refs Presented at the Intern. Centre for Theoret. Phys. Seminar, Trieste, Italy, 20 Aug. 1968
(IC-68-92) Avail: CFSTI

It is proved that to every proper orthochronous Lorentz matrix L there exists a distinct 1-parameter family of simply transitive non-Abelian 4-parameter subgroups G_4 of the Poincaré group G_{10}, each G_4 being specifiable in terms of the eigenvalues and eigenvectors of L. By this new finding, the pre-relativistic concept of absolute simultaneity is re-established on a new Lorentz-invariant basis, which appears to provide a new pathway to

a deeper conceptual framework of description for elementary particle theory, in terms of new geometrical concepts of internal structure relating to space-time. ESRO

N69-19706# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
SMOOTHING OF SPECTRA IN NUCLEAR PHYSICS [LISSAGE DE SPECTRES EN PHYSIQUE NUCLEAIRE]
Jean-Francois Mougel Dec. 1968 30 p In FRENCH; ENGLISH summary Prepared jointly with Lawrence Radiation Lab., Calif. Univ.
(CEA-R-3662) Avail: CFSTI

A method for spectra smoothing, using local corrections, is described and the consequences of smoothing, relative to changes of area and first moments are studied. This method, referring to very simple computations, can be used on a small computer with good results. Examples for true nuclear spectra are given. Author (ESRO)

N69-19708# Commissariat à l'Energie Atomique, Limeil (France).
REMARKS ON THE MOTION OF MACROSCOPIC AND MICROSCOPIC SPINNING PARTICLES IN RELATIVITY [REMARQUES SUR LE MOUVEMENT DES PARTICULES A SPIN MACROSCOPIQUES ET MICROSCOPIQUES EN RELATIVITE]
Raymond Micoulaut Sep. 1968 29 p refs In FRENCH; ENGLISH summary
(CEA-R-3563) Avail: CFSTI

The Papapetrou equations of motion of a spinning particle do not allow the unequivocal determination of the worldline described by the particle. The motion must be completely determined by adding a supplementary condition. For macroscopic particles, characterized by the conditions of Corinaldesi-Papapetrou and Tulczyjew and moving in a Schwarzschild field an additional term appears in the expression for the advance of perihelion. For microscopic particles a summary is given of the results obtained using the conditions of Weyssenhoff, Nakano, Hönl-Papapetrou and Wessel. Author (ESRO)

N69-19718# International Centre for Theoretical Physics, Trieste (Italy).
THE PHYSICAL INTERPRETATION OF SPACE-LIKE AND GHOST-LIKE SOLUTIONS OF INFINITE-MULTIPLET WAVE EQUATIONS
A. O. Barut Dec. 1968 9 p refs Submitted for publication
(IC/68/108) Avail: CFSTI

Whereas the time-like positive norm solutions of wave equations correspond to bound states and scattering states of a captured particle, the solutions with negative norm and the space-like solutions correspond to the states of a system when the particle is emitted. The norm has the physical interpretation of the number of particles per unit volume, positive for capture and negative for emission. The exchange scattering (i.e. u-channel poles and cuts) can now be obtained as solutions of a wave equation just like the s-channel poles and cuts (i.e. direct scattering). Author (ESRO)

N69-19719# International Centre for Theoretical Physics, Trieste (Italy).
ON THREE- AND FOUR-BODY SCATTERING PROCESSES
T. H. Rihan Jul. 1968 18 p refs Submitted for publication
(IC/68/60) Avail: CFSTI

The three- and four-particle Lippmann-Schwinger equations are used to derive uncoupled integral equations with properly connected kernels for the corresponding scattering operators. The three-body transition amplitude for elastic scattering and re-arrangement collisions obtained by considering only the inhomogenous term of the proposed equation coincides with that obtained previously from the second iterative solution to the corresponding Faddeev equations. In the case of four-particle elastic scattering, the inhomogeneous term leads to a Glauber-like formula after making some approximations reasonable for high-energy collisions. Author (ESRO)

N69-19720# International Centre for Theoretical Physics, Trieste (Italy).
A = 6 NUCLEI AS THREE-BODY SYSTEMS
V. A. Alessandrini (Univ. de la Plata), D. Avalos (Univ. de la Plata), L. Epele, H. Fanchiotti, C. A. Garcia Canal (Univ. de la Plata) et al 1968 7 p refs Submitted for publication
(IC/68/112) Avail: CFSTI

Light nuclei with A = 6, as ^{6}He and ^{6}Li, can be described reasonably by using a three-body model (alpha particle plus two nucleons) approximation. The Fadeev equations are solved by describing the alpha-N and N-N interactions by separable potentials. The results lend strong support to the three body model of A = 6 nuclei. ESRO

N69-19724# International Centre for Theoretical Physics, Trieste (Italy).
TEST OF A NEW SET OF N-N SEPARABLE POTENTIALS IN THE 3-N SYSTEM
V. A. Alessandrini and C. A. Garcia Canal Dec. 1968 5 p refs Submitted for publication
(IC/68/109) Avail: CFSTI

The binding energy of the triton is computed by searching for zeroes in the Fredholm determinant in the doublet state of the Tabakin potential, which produces a huge attraction due to the particular off-shell behavior of the two-body matrix implied by the potentials employed. Next, the singlet state Tabakin potential is used and it is concluded, that the Tabakin potential for the $^{1}S_{0}$ state can provide as good a description of the properties of the 3-N system at low energies as any other based on rank two separable potentials. ESRO

N69-19728# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
SPECTROSCOPIC STUDY OF NEAR CLOSED-SHELL NUCLEI Z = 50 BY MEANS OF THE (^{3}He,d) AND (d,^{3}He) REACTIONS ON ALL EVEN TIN ISOTOPES, AND THE (^{3}He,d) REACTION ON THE A = 113 AND A = 115 INDIUM ISOTOPES [ETUDE SPECTROSCOPIQUE DES NOYAUX AU VOISINAGE DE LA COUCHE FERMEE Z = 50, AU MOYEN DES REACTIONS (^{3}He,d) ET (d,^{3}He) SUR TOUS LES ISOTOPES PAIRS DE L'ETAIN, ET DE LA REACTION (^{3}He,d) SUR LES ISOTOPES 113, 115 DE L'INDIUM]
Samuel Harar (Ph.D. Thesis—Paris Univ., 1967) 1 Apr. 1968 137 p refs In FRENCH; ENGLISH summary
(CEA-R-3530) Avail: CFSTI

A systematic study of (^{3}He,d) reactions at 18 MeV incident energy and (d,^{3}He) reactions at 22 MeV incident energy on $^{112, 114, 116, 118, 120, 122, 124}$Sn is presented. The distorted wave Born approximation (DWBA) is used to extract information on: the transferred angular momentum lp, the change of parity, and the spectroscopic factor. The influence of the proton-neutron residual interaction on the spread of the pure proton configuration (particle or hole), and on the observed level sequence have also been investigated. Experimental results and predictions of the Kisslinger and Sorensen model are in reasonable agreement. A study of $^{113, 115}$In (^{3}He,d) $^{114, 116}$Sn reactions shows strong experimental

evidence that the proton particle-hole components are weak in the first excited states of tin nuclei. Furthermore, highly excited states (4 to 6 MeV) having a simple structure with one predominant particle-hole configuration have been located. Author (ESRO)

N69-19730# International Centre for Theoretical Physics, Trieste (Italy).

DISPERSION THEORY FOR AN ELECTRON-PHONON SYSTEM IN A MAGNETIC FIELD

Awele Maduemezia (Ghana Univ.) Aug. 1968 47 p refs Submitted for publication

(IC-68-72) Avail: CFSTI

A (non-relativistic) local field theory is constructed for a system of phonons interacting with electrons in a degenerate electron gas situated in a high strength magnetic field. Within the framework of this theory, the forward dispersion relation for high frequency phonons interacting with electrons in a normal metal is derived. The lower limit for the dispersion integral explains the (experimentally observed) phenomenon of 'giant quantum oscillations' in ultrasonic attenuation in metals. It indicates that there is a non-zero frequency threshold for the onset of this phenomenon. The cut on the phonon energy real axis is consistent with the physically reasonable condition that for positive energy phonons, phonon absorption occurs only when the electron and phonon 'collide head-on'. Author (ESRO)

N69-19732# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

STUDY OF A ONE-DIMENSIONAL MODEL FOR A SYSTEM OF INTERACTING FERMIONS [ETUDE D'UN MODELE A UNE DIMENSION POUR UN SYSTEME DE FERMIONS EN INTERACTION]

Michel Gaudin (Ph.D. Thesis—Paris Univ., 21 Nov. 1967) 14 May 1968 195 p refs In FRENCH; ENGLISH summary

(CEA-R-3569) Avail: CFSTI

A one dimensional model for a quantum system of fermions with attractive or repulsive interaction is studied and the eigenvalues and eigenfunctions of the Hamiltonian with periodic boundary conditions are exactly determined. The knowledge of the spectrum is applied to the study of the attractive gas, characterized by the presence of 'pairs' or two particle bound states. This system can be described as a gas of 'one dimensional deuterons', which has some analogy with a boson gas. Some ground state properties are discussed for all values of the coupling constant, e.g. energy as a function of the density and magnetization. The analytic properties of the energy function are studied, but not completely resolved. Finally elementary excitations of the phonon type are considered and the dispersion curves are given. Author (ESRO)

N69-19735# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

CONTRIBUTION TO THE STUDY OF TWO NUCLEONS TRANSFER REACTIONS. APPLICATION TO THE SPECTROSCOPIC STUDY OF ^{56}Co. [CONTRIBUTION A L'ETUDE DES REACTIONS DE TRANSFERT DE DEUX NUCLEONS. APPLICATION A L'ETUDE SPECTROSCOPIQUE DE ^{56}Co]

Jean-Marc Laget (Ph.D. Thesis—Paris Univ., 24 Jun. 1968) Oct. 1968 143 p refs In FRENCH; ENGLISH summary

(CEA-R-3572) Avail: CFSTI

The different ways computing the cross section for direct two nucleon reactions are presented. The results are compared to the experimental data on the ^{54}Fe(^{3}He,p)^{56}Co at (E(^{3}He) = 18 MeV) and the ^{54}Fe(t,p)^{56}Fe at (E (t) = 12 MeV) reactions. The analysis of the experimental results of the ^{54}Fe (^{3}He,p)^{56}Co at (E(^{3}He = 18 MeV) and the ^{54}Fe (t,p)^{56}Fe at (E (t) = 12 MeV) reactions provides a spectroscopic study of ^{56}Co. Author (ESRO)

N69-19743 Michigan Univ., Ann Arbor.

RESONANCE SCATTERING OF RADIATION BY INTERACTING ATOMS

Dwight Donald Hearn (Ph.D. Thesis) 1968 89 p

Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-13326

The resonance fluorescence of a system of two interacting atoms is investigated when the atoms are separated by distances that are large compared with atomic size. This study is devoted to the determination of the lifetimes of the intermediate states, the probability amplitude of the final state and the line-shape of the emitted radiation. Interactions taken into account are those between the atoms and the radiation field and the electrostatic interaction between the atoms. All calculations are carried out to the lowest order so that only two-level atoms are considered and electronic transitions involving the emission or absorption of more than one photon are neglected. Similarly, the electrostatic interaction between the atoms is restricted to the first-order dipole-dipole term. Calculations of the lifetimes and emission lineshape are based upon the time-dependent perturbation method developed by Heitler and Ma. Dissert. Abstr.

N69-19746# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

DETECTION OF A SPIN-DEPENDENT EFFECT IN THE GAMMA SPECTRUM FOLLOWING NEUTRON CAPTURE

C. Coceva, F. Corvi, P. Giacobbe, and G. Carraro 1968 13 p refs Presented at 2nd Conf. on Neutron Cross Sect. and Technol., Washington, D. C., 4–7 Mar. 1968

(RT/FI(68)36) Avail: CFSTI

In an effort to find a method of spin assignment of s-wave neutron resonances, the capture γ-ray spectrum was examined to see which features of it are dependent on the spin of the initial excited state. The starting point was the assumption that the multiplicity of the emitted γ-rays is dependent on the spin of the initial state. Although such a hypothesis may be supported by some qualitative argument, there is no definite experimental evidence of it. The simplest way of putting into evidence the multiplicity is to determine the ratio between the count rate of one gamma detector and the coincidence count rate of two gamma detectors viewing the capture gamma ray source. The ratio, while being obviously independent of the neutron flux and the resonance parameters, retains a dependence on the multiplicity and on the shape of the capture gamma spectrum. Author

N69-19750 Georgetown Univ., Washington, D. C.

THE MEASUREMENT PROBLEM IN AFFINE GEOMETRIES

Louis Derry (Ph.D. Thesis) 1968 143 p

Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-12805

In the Riemannian geometry of the general theory of relativity the measurement problem is always discussed through appeal to the local Minkowski spaces which can be set up at any point of the manifold and wherein the measurement prescriptions of special relativity are valid. It is pointed out, however, that if one sets up a non-Riemannian affine space in an attempt to describe the lack of a principle of equivalence for nongravitational fields, these local Minkowski spaces no longer exist; and in consequence, one no longer has recourse to the precepts of classical measurement theory. These difficulties are not altogether unwelcome, and indeed, attempts have been made to exploit them. Certain objections to London's method are raised, and an alternate approach to the measurement problem in a Weyl space suggested. It is proposed that in the light of modern quantum theory some degree of uncertainty in the results of measurements ought to be allowed. If this be granted, it becomes necessary to distinguish between

"mathemtical coordinates," which are simply convenient labels for the points of the manifold, and "physical coordinates," thought of as resulting from some given measurement scheme. It is argued that in a given observation certain results will be more likely than others, and a variational principle is put forward which purports to identify those aspects of particle motion most likely to be observed.
Dissert. Abstr.

N69-19751# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
HALF-SPACE TRANSPORT PROBLEMS WITH ANISOTROPIC SCATTERING
T. Trombetti 1968 23 p refs
(RT/FI(68)44) Avail: CFSTI

An exact solution to the linear transport problem in a half space with anisotropic scattering and general conditions on the free surface and at infinity is explicitly given. The albedo or diffuse reflection problem is treated as a particular case. Author

N69-19758# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
CROSS SECTIONS FOR ENERGY TRANSFER IN CLASSICAL COULOMB COLLISIONS
P. C. T. de Boer Aug. 1968 53 p refs Sponsored jointly by the Heinemann Found., NSF, and NATO
(VKI-TN-48) Avail: CFSTI

Gryzinski's derivation of cross sections for energy transfer is reconsidered. An inconsistency in averaging over all possible collisions is removed. The cross section Q(U) for energy transfer of at least U is calculated for arbitrary mass ratio of the collisions partners. The differential cross section $\sigma(U)$ for energy transfer U follows by differentiation. Different expressions for Q and σ apply in various regions of a diagram, the coordinates of which represent non-dimensionalized mass and non-dimensionalized energy of the incident particle. Results are given for the strictly classical case, as well as for an empirical modification which is equivalent to one proposed by Gryzinski. After a consideration of various ways in which the results can be improved empirically, it is concluded that the most straightforward procedure consists of calculating cross sections by scaling laws. In many instances, this procedure may be expected to give better accuracy than other methods.
Author (ESRO)

N69-19770# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
LEPTONIC DECAYS OF VECTOR MESONS: THE BRANCHING RATIO OF THE ELECTRON-POSITRON DECAY MODE OF THE PHI MESON
V. Becker, William K. Bertram, M. Binkley, C. L. Jordan, T. M. Knasel et al Oct. 1968 11 p refs Prepared jointly with MIT
(DESY-68/56) Avail: CFSTI

An experiment designed to measure the branching ratio of the phi meson to e^+e^- was performed by measuring phi production and phi decay to e^+e^- with the same apparatus. The results of this experiment yield a branching ratio of $(2.9 \pm 0.8) \times 10^{-4}$. This result is compared with various theoretical predictions. Author (NSA)

N69-19771# Deutsches Elektronen-Synchroton, Hamburg (West Germany).
INELASTIC ELECTRON PROTON SCATTERING AT HIGH MOMENTUM TRANSFERS
W. Albrecht, F. W. Brasse, H. Dorner, W. Flauger, K. Frank et al Sep. 1968 19 p refs
(DESY-68/48) Avail: CFSTI

Inelastic electron–proton scattering has been measured by detecting the scattered electron, thus obtaining the total absorption cross section for virtual photons. Two complete spectra from threshold to a pion nucleon mass of $W = 2$ GeV were taken at 48.3° and fixed primary energies of 3.963 GeV and 5.159 GeV, respectively, corresponding to a momentum transfer at the first resonance of $q^2 = 3.98$ $(GeV/c)^2$ and $q^2 = 5.84$ $(GeV/c)^2$. In addition, a measurement at 47.9° and at a primary energy of 3.306 GeV in the region of the first resonance is reported.
Author (NSA)

N69-19789# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
DETECTION OF α PARTICLES USING SEMICONDUCTORS. APPLICATION TO THE CONTROL OF PLUTONIUM EXTRACTION [DETECTION DES PARTICLES α PAR SEMICONDUCTEURS. APPLICATION AU CONTROLE DE L'EXTRACTION DU PLUTONIUM]
Jean Tanguy (Ph.D. Thesis—Paris Univ., 21 Mar. 1968) Mar. 1968 204 p refs In FRENCH; ENGLISH summary
(CEA-R-3442) Avail: CFSTI

Particles produced by thick sources were examined using either diffused junction or surface barrier semiconductor detectors in order to continuously control the plutonium extraction process. Equipment in which the solutions to be analyzed flow in contact with the detector which is protected by a thin mica membrane is described. Precise recording of the spectra separates the two or more α-emitters present in the same solution, and this method has been applied to the measurement of ^{239}Pu in the presence of ^{241}Am with an accuracy of ± 5 per cent. The second part of the report deals with the detection of plutonium in solutions of $\beta-\gamma$ emitti ng fission products, based on a fast amplification chain and totally depleted thin detectors. Under these conditions a few mg of ^{239}Pu can be detected in solutions of fission products having an activity of 100 curies/liter. A method is given for discriminating α and β particles, based on the difference in the collection times for the charges liberated by these particles in the detector. Author (ESRO)

N69-19795 Washington Univ., Seattle.
THE EXCITON-MOLECULAR VIBRATION INTERACTION IN MOLECULAR CRYSTALS IN THE STRONG COUPLING LIMIT
Bruno Mario Fanconi (Ph.D. Thesis) 1968 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-12687

The system of excitons interacting weakly with molecular vibrations is treated using many-body Green's functions. In this treatment the single molecule is restricted to two vibrational levels and the Hamiltonian for an aggregate of these molecules is developed. Approximations are obtained to both the double-time Green's function and its Fourier transform. The complex susceptibility is determined from the frequency dependent Green's function. The double-time Green's function is analyzed to obtain the first and second moments of the $k = 0$ exciton energy level.
Dissert. Abstr.

N69-19808# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
THE HARTREE-FOCK THEORY FOR THE FORM OF LIGHT NUCLEI EQUILIBRIUM [THEORIE HARTREE-FOCK DE LA FORME D'EQUILIBRE DES NOYAUX LEGERS]
Georges Ripka (Ph.D. Thesis—Paris Univ.) Sep. 1968 180 p refs In FRENCH; ENGLISH summary
(CEA-R-3404) Avail: CFSTI

The Hartree-Fock equations are derived and the expansions of the orbits and the possible symmetries of the Hartree-Fock field are discussed. Wavefunctions of even-even N-Z nuclei are given for $12 \leq A \leq 40$ and the role of the monopole, quadrupole and exchange components of the force are discussed. The multiplicity of the solutions and the effect of the spin-orbit interaction are also considered. Exact angular momentum projection is used to generate rotational bands and the validity of the adiabatic rotational model in light nuclei is studied. The Hartree-Fock calculations are extended to include major shell mixing in order to obtain quadrupole deformations without the use of effective charge. The incompressibility of nuclei is also discussed and the compatibility between the Hartree-Fock solutions, the Mottelson model of quadrupole deformations and the SU3 states of J.P. Elliott and M. Toshinsky is established. Author (ESRO)

N69-19809# International Centre for Theoretical Physics, Trieste (Italy).

CROSSING SYMMETRY IN THE O(4,2) FORMULATION OF THE DIRAC THEORY

A. O. Barut, P. Cordero (Chile Univ), and G. C. Ghirardi (Trieste Univ.) Oct. 1968 22 p refs Submitted for publication
(IC-68-96) Avail: CFSTI

The formulation of the Dirac theory based on the group O(4,2) is discussed in detail, in which an internal additive quantum number n appears, distinguishing particles and antiparticles. The substitution law then becomes an analytic continuation in n. Author (ESRO)

N69-19814# California Univ., Livermore. Lawrence Radiation Lab.

PROCESSING OF DATA FROM A γ SPECTROMETER [TRAITEMENT DES INFORMATIONS ISSUES D'UN SPECTROMETRE γ]

Jean-Pierre Boulanger Oct. 1968 63 p refs Transl. into ENGLISH of French rept. CEA-R-2991
(UCRL-Trans-10293) Avail: CFSTI

After briefly recapitulating the principle of the method of least squares, the problems raised by the processing of data contained in a γ spectrum are studied. The measurement of the energy and relative intensity of the γ radiation by means of the abscissa and area of the total-absorption peak, the calculation of the activity of the components in a mixture, and determination of impurities are discussed. Experimental results relating to the systematic testing of the capabilities of the methods used are considered. Author (NSA)

N69-19828*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LITHIUM-DRIFTED SILICON DETECTORS AS LOW-ENERGY PHOTON SPECTROMETERS

Sherwin M. Beck Washington Mar. 1969 23 p refs
(NASA-TN-D-5056) Avail: CFSTI CSCL 20H

Lithium-drifted silicon detectors were fabricated from 10,000 ohm-centimeter, p-type silicon and were tested for use as low-energy photon spectrometers. Three X-ray and gamma ray sources (Am^{241}, Co^{57}, Cd^{109}) were used to determine the energy resolution. At 77° K and less than 10^{-5} torr (1.33 mN/m^2) the detector resolution varied from 0.82 keV (full width half maximum (FWHM)) at a photon energy of 22.10 keV to 1.04 keV (FWHM) at 122.05 keV with detector-amplifier noise (measured with a pulse generator) almost constant at 0.75 keV (FWHM). From these measurements an intrinsic detector resolution corresponding to a Fano factor of 0.205 was calculated. Author

N69-19830*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.

THE VISIBLE AFTERGLOW OF ACTIVE NITROGEN [DAS SICHTBARE NACHEUCHTEN DES AKTIVEN STICKSTOFFES]

G. Cario et al Washington NASA Feb. 1969 12 p refs Transl. into ENGLISH from Z. Physik (Berlin), v. 58, 1929 p 769-780
(Contract NASw-1692)
(NASA-TT-F-12003) Avail: CFSTI CSCL 07D

The activity and long lifespan of active nitrogen rests on the dissociation of nitrogen in atoms. The spectrum of the visible afterglow of active nitrogen is studied in order to determine how the emission of the afterglow occurs at the expense of the free energy during the recombination of nitrogen atoms to molecules. The result was that the bands of the first positive group observed in the afterglow were emitted in the visible spectral region by nitrogen molecules, which then are excited to the metastable condition by a collision of the second sort with metastable nitrogen atoms in ^2P- and in the ^2D- level, to $B_{1\Sigma}$- and to the B_6-level. These metastable molecules and atoms are constantly delivered at the expense of recombination energy. Author

N69-19835# New York Univ., N. Y. Radiation and Solid State Lab.

THE INTERACTION OF RADIATION WITH MATTER A Comprehensive Report, 1962-1968

Dec. 1967 100 p refs
(Contract AT(30-1)-2962)
(NYO-2962-7) Avail: CFSTI

A general review on the interaction of radiation with matter including fluorescence, ionization, persistent internal polarization, and energy transfer reactions is presented. A review on heavy ion research is also presented. This research includes development of heavy ion accelerator facility, channeling, screening of heavy charged particles in semiconductors, characteristic x-ray production by heavy ions, unified sputtering theory, and channeling in organic crystals. NSA

N69-19836# Minnesota Univ., Minneapolis. School of Physics.

EFFECT OF D-STATE IN DEUTERIUM SCATTERING

E. Coleman and T. G. Rhoades 29 Oct. 1968 10 p refs
(Contract AT(11-1)-1704)
(COO-1764-19) Avail: CFSTI

The results of the Glauber high energy approximation including double charge exchange and the deuteron D-state are compared with existing pion-deuteron and proton-deuteron data. Inclusion of the D-state is shown to transform the former interference region to a shoulder-like region in most cases. Author (NSA)

N69-19839 Washington Univ., Seattle.

THE LOW ENERGY BARYON-BARYON INTERACTION

William Michael Dante (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-12683

A model is proposed which uses a potential in a Schroedinger equation to obtain phase shifts, scattering lengths, and effective ranges. The potential is obtained by summing the allowed one boson exchange potentials for the observed mesons. SU(6)W symmetry, broken by a spurion with the quantum numbers of the eta meson, is used to obtain the coupling constants. Deviations from exact symmetry are further taken into account by using the physical masses for both the exchanged mesons and the baryons. At short range the potential is replaced by a boundary condition that is assumed to be invariant under, at least, SU(3). The model is not particularly sensitive to the boundary radius which is chosen to be

consistent with no binding in the singlet n-p system. The paucity of experimental data leaves us with only one comparison that can be made with experiment. The agreement here is poor and it is suggested that the sensitivity of the model to the boundary condition makes the assumption of SU(3) symmetry invalid. A number of suggestions are made for improvement of the model. A 2.4 MeV bound state of the sigma cascade in the spin 0, isospin 3/2, channel is a prediction of the model which may be worth some experimental investigation. Dissert. Abstr.

N69-19842# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
A QUANTAL APPROACH TO THE PROBLEM OF NEUTRON MULTIPLE SCATTERING IN A SLAB
N. P. Kalashnikov and G. Longo 8 Oct. 1968 13 p refs
(RT/FI(68)40) Avail: CFSTI

The solution of a neutron multiple scattering problem is obtained by using a quantal approach. The elastic isotropic scattering is considered in the approximation where the scattering length is much less than both the neutron mean free path and the average distance between nuclei. In the case of a finite thickness slab, the probability density of the neutron momenta as a function of the traversed depth and of the scattering cosine is written directly in quadraturs without using the transport equation. Author

N69-19883# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
QUADRUPOLE DIRECT CAPTURE
G. Longo and F. Saporetti 1968 20 p refs
(RT/FI(68)50) Avail: CFSTI

An expression of the cross section for the quadrupole radiative capture of nucleons by nuclei via direct mechanism is obtained. The ^{142}Ce (p, γ) reaction is investigated in the (10 to 50) MeV energy range. It is shown that for proton energies above 20 MeV the quadrupole contribution to the cross section may be of the same order of magnitude as the dipole one. Author

N69-19884# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
SPACE-ENERGY NEUTRON KINETICS IN CYLINDRICAL GEOMETRY
T. Trombetti 1968 31 p refs
(RT/FI(68)38) Avail: CFSTI

The problem of neutron kinetics in two dimensional geometry, i.e. the problem of determining the space-angle-energy description of the time-dependent neutron flux distributions is solved. The general case of anisotropic scattering is considered first, and the solution is given the form of an inverse Laplace transform. Finally it is shown that, in the case of isotropic scattering, this solution splits into the sum of exponential modes plus a transient term. Author

N69-19906# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
RHO PRODUCTION WITH POLARIZED PHOTONS
L. Criegee, M. H. Garrell, C. Gottfried, A. Krolzig, G. Loeffler et al Sep. 1968 13 p refs
(DESY-68/50) Avail: CFSTI

The process $\gamma + p \rightarrow p + \rho^0 \rightarrow p + \pi^+ + \pi^-$ has been studied with polarized photons between 2.0 and 2.5 GeV. Decay pions and recoil proton were detected with a wire plane system. A strong preference for ρ^0 decay parallel to the polarization vector is found, expressed by the ratio $\sigma_\perp/\sigma_\parallel = 0.17 \pm 0.07$, which indicates the predominance of diffractive rho production. Author (NSA)

N69-19922# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
EFFECTIVE SOLUTIONS TO THE PROBLEMS OF NEUTRON TRANSPORT KINETICS IN ONE AND THREE DIMENSIONS
J. Mika, R. Stankiewicz (Inst. of Nucl. Res., Swierk, Poland), and T. Trombetti 1968 29 p refs
(RT/FI(68)32) Avail: CFSTI

In this paper the time-dependent, space-angle-energy distributions of neutron flux in one and three dimensions are determined as the solutions of the corresponding initial value transport problems. In either case the solution is expressed as a sum of exponential modes plus a residual term which is shown to become asymptotically negligible. It is seen that these expressions are well suited, for practical engineering and physical purposes, to the investigation of the kinetic behaviour of neutron flux distributions. Author

N69-19941 Minnesota Univ., Minneapolis.
A COVARIANT FORMULATION OF SPIN AND REPRESENTATIONS OF THE LOCAL CURRENT ALGEBRA
William Allan Bardeen (Ph.D. Thesis) 1968 55 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-12237

Covariant representations of the Wigner "little group" were constructed for single particle states of definite momentum. The matrix elements of scalar operators between the covariant spin states are shown to be invariant amplitudes. The corresponding covariant Rarita–Schwinger wavefunctions were constructed as functionals of the momentum four-vectors. These wave-functions were used with Green's functions of Rarita–Schwinger interpolating fields to study the kinematic singularities and crossing properties of the invariant amplitudes. The covariant spin states and the infinite momentum limit were used to obtain a general representation of the local current algebra. A representation in terms of a set of single particle states having a mass—spin relation is considered. The current algebra implies a nonlinear relation between the invariant form factors. The analytic structure of the form factors as functions of the momentum transfer is shown to place a constraint on the spectrum of the single particle states used in the representation. Dissert. Abstr.

N69-19951# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.
ELASTIC SCATTERING OF ALPHA PARTICLES ON K-39 NUCLEI IN THE ENERGY RANGE FROM 22.1 MeV TO 28.2 MeV
A. Bobrowska, A. Budzanowski, K. Grotowski, L. Jarczyk, S. Micek et al 1968 35 p refs
(INP-813/PL) Avail: CFSTI

Angular distributions for elastic scattering of alpha particles on ^{39}K nuclei were measured over the angular range from 20 to 179° (center of mass) at alpha particle energies 22.1, 23.1, 23.6, 24.0, 24.6, 25.5, 26.5, 27.4, and 28.2 MeV. A strong increase of the cross section with well-developed oscillatory character was observed at the backward scattering angles. The experimental data are fitted with the semiclassical diffraction model at forward angles and the glory scattering model at backward angles. A difference of about 1 fm in radius parameters for both models was found. Author (NSA)

N69-19952 Florida Univ., Gainesville.
ASSOCIATIVE AND DISSOCIATIVE IONIZATION OF GASES ON IMPACT OF METASTABLE ATOMS
John Austin Herce (Ph.D. Thesis) 1967 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-13010

Measurements of mass spectra for the ionization of atoms and molecules on impact of excited atoms were made using a mass spectrometer modified for molecular beam experiments. The ions formed are extracted from the collision region at right angles to an incident beam of metastable helium atoms or metastable neon atoms excited by electron impact. Long-lived states of higher excitation are removed from the beam by a quenching field. Measurements of the relative ion abundances as a function of the exciting electron energy, thereby changing the population of the metastable state in the beam, yield abundances for each metastable species. Using the known total ionization cross sections, separate cross sections were then calculated. Dissert. Abstr.

N69-19953 California Univ., Berkeley.
PENETRATION OF HIGH ENERGY, HEAVY IONS, WITH THE INCLUSION OF COULOMB, NUCLEAR, AND OTHER STOCHASTIC EFFECTS
Gerald Murray Litton (Ph.D. Thesis) 1967 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-10361

A general method has been developed for calculating Bragg curves, flux curves, and energy spectra resulting from beams of high energy, heavy ions incident on an arbitrary target. The method takes into account the processes of energy loss from both electronic and nuclear elastic collisions, nuclear attenuation, small-angle multiple scattering, and straggling, as well as effects due to initial energy and angular spreads of the beam. Calculations are made for ions of various atomic numbers incident on different targets. It is found that for a given range in a particular target, the peak-to-plateau dose ratio goes through a maximum as the atomic number of the incident ions increases. Similarly, the Bragg peak full-width at half-maximum goes through a minimum. Dissert. Abstr.

N69-19962# International Centre for Theoretical Physics, Trieste (Italy).
SOME REMARKS ON A BOOTSTRAP MODEL BASED ON DUALITY
V. A. Alessandrini Oct. 1968 12 p refs Submitted for publication
(IC-68-100) Avail: CFSTI

Consideration is given to bootstrap calculations exploiting the idea of duality and starting by assuming that the scattering amplitude A(s,t) can be represented either by a sum of s-channel resonances or by a Regge pole with trajectory function $\alpha(t)$. It is noted that, at fixed cosθ, Im A(s, cosθ) as obtained from the s-channel resonances is an oscillating function of s, and that the same holds for the second representation. By requiring that the periods of the oscillations in s of both representations should match, a relation between the s and t-channel Regge trajectories is obtained, and such a constraint equation is considered in more detail. It is shown that solutions exist only if the equation is considered valid over all the physical region in s, whence it follows that either the duality concept is incorrect or the constraint equation has to be supplemented. ESRO

N69-19963# Institut d'Aéronomie Spatiale de Belgique, Brussels.
ABSORPTION IN THE SPECTRAL RANGE OF THE SCHUMANN-RUNGE BANDS
M. Ackerman, F. Biaume, and M. Nicolet 1968 15 p refs Presented at the I.A.G.A. Symp. on Lab. Meas. of Aeronomic Interest, Toronto, 2–4 Sep. 1968 Submitted for publication *Its* Aeronomica Acta A-56
Avail: CFSTI

Absorption of silicon lines by O_2 in the Schumann-Runge bands has been measured. The results lead to some conclusions about the nature of the absorption and about the general behavior of the spectrum. Author (ESRO)

N69-19966 Purdue Univ., Lafayette, Ind.
DETECTION OF MODULATED MOLECULAR BEAMS WITH ELECTRON BOMBARDMENT DETECTORS AND STUDIES OF ARGON-ARGON SCATTERING
John Saverio Penta (Ph.D. Thesis) 1968 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-12600

The necessary instrumentation was developed which permitted the measurement of absolute differential scattering cross sections for the argon–argon system using crossed molecular beams. The beams were at thermal energy and contained Maxwellian velocity distributions. The Ar–Ar total scattering cross section was also measured. This was accomplished by combining beam modulation and phase-sensitive detection with very sharp tuning on the front end of the lock-in amplifier and long integration times on the back end. Two different kinds of electron bombardment detectors, an Aberth ion-source and a quadrupole mass filter, were used. With this detection system and the Aberth ion-source a scattered beam could be detected to 1 part per 10^3, whereas with the quadrupole mass filter a scattered beam could be detected to 1 part per 10^4. In addition, a 41 cycle per second AC beam signal could be retrieved from a DC background which was 10^8 times the beam signal. Dissert. Abstr.

N69-19976 Pennsylvania State Univ., University Park.
ON THE STOCHASTIC FORMULATION AND INTERPRETATION OF NEUTRON TRANSPORT EQUATIONS
Chio-min Yang (Ph.D. Thesis) 1967 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-12017

The two lowest order equations in the hierarchy of statistical relations are considered. Concepts such as singlet and doublet particle densities and their relations to the mean and variance of a neutron population are developed. The Green's function, in the stochastic sense, is defined; and the effects on the density of neutrons at a phase point and time due to various kinds of interactions at another phase point and earlier time are deduced. Two relations describing neutron probability balance are constructed, which, along with the other concepts, allow the singlet and doublet density equations to be derived. The doublet density equation of neutron transport derived by stochastic methods contains two phase points and two arbitrary times as independent variables. A formal solution for the doublet density equation is found which contains Green's functions, the singlet density, and the various parameters of the system. Registrations of neutron counting are regarded as fictitious stationary particles, and their doublet and singlet densities are defined. Equations governing behaviors of these counting particles are presented. Dissert. Abstr.

N69-19983 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
MICROWAVE SPECTROSCOPY
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 7-8 (See N69-19981 09-34)
(Contract DA-28-043-AMC-D2536(E))
Avail: CFSTI

Microwave spectroscopic measurements on the magnetoresistance of a conducting solid are performed by determining electromagnetic power absorption of conduction electrons. Magnetic field dependence and power absorption calculations are verified experimentally for thin copper film. Proposed is also the spectroscopic measurement of electron contribution to the ultrasonic acoustic attenuation coefficient in a metal. G.G.

N69-20005# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
CALCULATION OF THE ENERGY DISTRIBUTIONS OF LIGHT NUCLEI ACCOMPANYING THE FISSION OF U-236
J. Blocki and T. Krogulski 1968 18 p refs
(INR-932; REPT-932/IA/II/PL) Avail: CFSTI

The Geilikman model dealing with the emission of α particles in the fission of ^{236}U was modified and extended to other particles. This model treats classically the motion of the third particle in the mutual Coulomb field of the two fragments. The system of these three bodies is parametrized in terms of the initial dynamic variables, some of them arbitrarily fitted. The calculations performed for several kinds of particles indicate that the approach which gives satisfactory fit for particles with Z = 2 demands quite different parametrization for particles with Z = 1. Author (NSA)

N69-20011# Akademiya Nauk URSR, Kiev. Institut Teoreticheskoi Fiziki.
THE KINETICS OF THE SPACE UNIFORM BOSE CONDENSATE
S. V. Peletminskii, V. D. Tsukanova, and A. A. Yatsenko 1968 39 p refs In RUSSIAN; ENGLISH summary
(ITF-68-51) Avail: CFSTI

The integral equations are obtained for the nonequilibrium density matrix of the system of particles in the state of Bose condensation, in which the operators of creation and annihilation are considered as C numbers. The latter is based on the principle of the spatial relaxation of correlations. When formulating the equations for the density matrix, essential are the gradient transformations of the first kind which make it possible to eliminate the phase of the condensate particles changing rapidly with time from these equations. The kinetic equations for quasi particles and for the number of particles in the condensate are obtained in the weak-interaction gas model. Author (NSA)

N69-20040 California Inst. of Tech., Pasadena.
QUANTUM MECHANICS OF ONE-DIMENSIONAL TWO-PARTICLE MODELS. PART 2: A QUANTUM MECHANICAL TREATMENT OF INELASTIC COLLISIONS
Dennis Jon Diestler (Ph.D. Thesis) 1968 215 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 68-12735

Solutions of Schrödinger's equation for systems of two particles bound in various stationary one-dimensional potential wells and repelling each other with a Coulomb force are obtained by the method of finite differences. The general properties of such systems are worked out in detail for the case of two electrons in an infinite square well. The system of two electrons in a parabolic well is also treated by finite differences. A general method of treating inelastic collisions quantum mechanically is developed and applied to several one-dimensional models. The theory is applied to the impulsive collision of a free particle with a particle bound in (1) an infinite square well and (2) a parabolic well. Calculated transition probabilites agree well with previously obtained values. Several models for the exchange reaction involving three identical particles are also treated. Dissert. Abstr.

N69-20049 Brandeis Univ., Waltham, Mass.
ORDINARY AND HIGHER RANDOM PHASE APPROXIMATIONS IN THE LUTTINGER MODEL
Newton John Kupelian (Ph.D. Thesis) 1968 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-12437

The Luttinger model, an exactly solvable model for fermions interacting via genaral two-body forces, is used as a theoretical laboratory for testing a sequence of decoupling approximations commonly referred to as the random phase approximations (RPA), the most familiar of which is the lowest. The contention is investigated that the successively higher orders of RPA give a uniformly converging sequence of results for quantities such as the ground-state energy, the modes of excitation and their spectrum, and the momentum-space distribution $\overline{n}_k$ of particles in the system ground state. It is found that the exact excitation modes and the corresponding spectrum, as well as the exact correlation energy, can be obtained in the lowest RPA. The next higher RPA gives a vanishing contribution to these quantities and again leads to a free-gas distribution in the bulk limit. Dissert. Abstr.

N69-20055# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Centro di Calcolo.
EXACT SOLUTION TO THE THREE-DIMENSIONAL TRANSPORT EQUATION FOR MONOENERGETIC NEUTRONS
V. C. Boffi and V. Molinari 1968 28 p refs
(RT/FI(68)43) Avail: CFSTI

A new method for integrating the Boltzmann integro-differential equation governing the monoenergetic neutron stationary flux distributions in a moderator parallelepiped is presented. The scattering is taken to be isotropic in the laboratory system. The central problem is shown to consist in the inversion of the three-dimensional Fourier transform of the total flux, such transform being the solution of a non-Fredholm integral linear equation in three variables. The angular dependence of the flux is also considered. Author

N69-20063 Purdue Univ., Lafayette, Ind.
AN ANALYSIS OF THE EFFECTS OF CROSS SECTION UNCERTAINTIES ON THE MULTITABLE S_n SOLUTION OF NEUTRON TRANSPORT THROUGH AIR
David Leon Prezbindowski (Ph.D. Thesis) 1968 238 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 68-12602

A rapid systematic method of evaluating the effects of cross section measurement errors on the multigroup flux as a function of space and group is derived for a source problem in spherical geometry. The method utilizes the adjoint flux solution and is derived assuming that the source problem is being solved by a multitable S_n method. The adjoint analysis method is applied to the problem of the deep penetration of neutrons in atmospheric air. A thorough analysis of the sensitivity of the multigroup fluxes to cross section measurement errors in nitrogen is given. Also included are comparisons of the results of the adjoint analysis method and the method of subtracting the unperturbed flux solution from a flux solution which is perturbed due to cross section perturbations. A comparison of computational time required by the two methods is included. The sensitivity analysis of the cross section measurement errors in nitrogen shows that the adjoint analysis method results give a valuable insight into the space and energy variation of the sensitivity of the neutron flux to cross section measurement errors. The comparison of the adjoint method with the method of subtracting perturbed and unperturbed fluxes shows that the results of these methods are in essential agreement. The comparison of computational times required by the two methods to analyze three different problems shows that the adjoint method requires from one-quarter to one-tenth less computational time. Dissert. Abstr.

N69-20079 California Univ., Los Angeles.
NEUTRON WAVE PROPAGATION THROUGH AN INTERFACE
Orlino Castro Baldonado (Ph.D. Thesis) 1968 280 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.60 Order No. 68-12458

Neutron wave propagation in a system consisting of two half spaces having different properties, adjecent at $x = 0$ is investigated using four different models: Model A—One-Speed Diffusion Theory; Model B—One-Speed Transport Theory; Model C—Energy Dependent Diffusion Theory; and Model D—Energy Dependent Transport Theory. An oscillating source at $x = -\infty$ in medium (1) is assumed, and the scattering kernel in Models B and D is assumed to be one-term degenerate. The solutions are identified in terms of incident (I), reflected (R), and transmitted (T) components. The elementary solutions for each model are found, and these are used to write the general solution. Except for Model C where the continuum solutions are neglected in the evaluation of the expansion coefficients, the analyses given are exact. The continuum coefficients in Model B are evaluated by solving an inhomogeneous Riemann–Hilbert problem, and the continuum coefficients for Model D are evaluated by solving a generalized Riemann–Hilbert problem.
Dissert. Abstr.

N69-20091 Vanderbilt Univ., Nashville, Tenn.
A STUDY OF SPACE-TIME TRANSFORMATIONS THAT PRESERVE TIME ORDERS
Robert Marion Brown (Ph.D. Thesis) 1967 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-12801

A relativistic study of a collision experiment in terms of a space-time network of events which describe the experiment is presented. In particular, a group of space-time transformations of the coordinates and momenta of the particles and equipment used in the experiment was sought which is not simply the Poincaré group, but which does maintain the essential features of the experiment: correct time orders and positive energies. Results were anticipated on the dynamics of the collision or information related to the mass spectrum problem. A procedure for locating an event is discussed, and various event variables are developed. The Lie products of such variables are calculated, and three different approaches to defining the desired group in terms of such variables are presented. First, an attempt is made to construct a Lie algebra out of a set of operators, all of which are constrained to preserve the sign of a given dynamical variable. A second attempt was to define the group so that its effect on the collision investigated is equivalent to that of a Poincaré group on that event. Such a group is interesting because its effect on the final state of the collision is known, and thus both initial and final state energies and time orders can be investigated. The final attempt considered any transformations that act as Poincaré transformations on the collision investigated and used the fact that the momenta and coordinates of that collision must enter the generators of the desired group in the form $M^{\mu\nu}$, the total angular momentum, and P^{λ}, the total linear momentum for the collision.
Dissert. Abstr.

N69-20105 IIT Research Inst., Chicago, Ill.
ELASTIC SCATTERING OF PROTONS BY Mg 26
Marvin Clark Mertz (Ph.D. Thesis) 1965 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 66-15531

Differential cross sections for elastic scattering of protons by Mg^{26} have been measured using solid-state diode detectors at laboratory angles of 90.2°, 120.3°, 135°, and 165°. Protons in the energy range from 0.85 to 4.58 MeV, corresponding to excitation energies from 9.10 to 12.72 MeV in Al^{27}, were obtained from three different electrostatic accelerators. About 114 levels were seen; spin and parity were assigned to 25, l values to 16, and tentative spin or l values to 38 more; 35 levels remain unassigned. As expected from shell-model consideration, negative-parity states predominate, contributing about four times the total reduced width of the normal-parity states. Seven of the strongest levels have the right l values, energies, and relative intensities to be isobaric analogs of levels in Mg^{27}. Good agreement was found with Mg^{26} (p,γ) work and with the data of a previous low-resolution Mg^{26}(p,p) experiment.
Dissert. Abstr.

N69-20109 Rochester Univ., N. Y.
SELF CONSISTENT CALCULATION OF THE MEDIUM STRONG AND ELECTROMAGNETIC MASS SPLITTINGS OF THE BARYON OCTET
Stephen L. Cohen (Ph.D. Thesis) 1968 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-9363

A mechanism is suggested whereby the medium strong and electromagnetic mass splittings within the baryon octet might arise as a dynamical consequence of the SU_3 violating medium strong and electromagnetic interactions. For the dynamical mechanism, the Lehmann spectral representation is used for the baryon inverse two point function, assuming that the occurrence of mass splittings within the baryon octet may be understood as being generated, as a low energy effect, by the mass splittings within the pseudo-scalar meson octet. Thus the meson mass splittings constitute the driving force for the baryon mass splittings. The result is that expressions for the baryon mass splittings are arrived at which involve three parameters: the very strong SU_3 symmetric coupling constant g^2, the parameter f which measures the relative weighting of F type and D type coupling, and a cutoff Λ which is a consequence of the usual divergences of perturbation theory.
Dissert. Abstr.

N69-20153 New York Univ., N. Y.
HIGHER DIMENSIONAL FIELD THEORY
Henry Frank Ahner (Ph.D. Thesis) 1968 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-13103

Four equations of physics (the Einstein Relativistic Field Equation, the Dirac Equation, the Klein–Gordan Equation, and the Vector Wave Equation) are examined in geometrical spaces that have more than four dimensions. A principle of dimensionality minimality is presented and used to limit the number of topological spaces considered. The n-dimensional spaces may be split into two smaller spaces whose lower symmetry is determined by the topology assumed for the larger space. The topology is always taken such that one of the smaller spaces is four dimensional with a Poincare symmetry group. Then the other space can have the Yang–Mills SU(2) isospin symmetry group when n is six and the SU(3) symmetry group when n is eight. An approximation procedure is developed which may be used to determine the values of the metric components. When it is utilized the SU symmetries are broken but the dimensionality of the particle representations is unchanged.
Dissert. Abstr.

N69-20172# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
ABSORPTION OF GAMMA RAYS IN FLUORINE AND NITROGEN
N. Bezic, D. Brajnik, D. Jamnik, G. Kernel, and J. Snajder May 1968 112 p refs
(NIJS-R-533) Avail: CFSTI

Total absorption of gamma-rays in fluorine and nitrogen were measured in the energy region from 8 to 31 MeV. The method of measurement was previously described; however, some improvements were introduced to increase the statistics and minimize the systematic errors. Photons from the 35 MeV betatron were analysed by a new Compton magnetic spectrometer with four energy channels. The magnet had a banding angle of 120° and an average radius of the electron paths of 33 cm. The current through the magnet and quadrupole was electronically stabilised to one part in 10^4 and the magnetic field as measured by the rotating

fluxmeter varied less than 0.02% per hour. A new fast counting system consisting of Cerenkov radiators with 56 AVP phototubes and fast discriminators had a dead time of 90 ns. With the betatron X-ray pulse of 60 μs the dead correction was smaller than 0.2% at the highest counting rate. Author

N69-20173# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
EMPIRICAL TREND OF THE (n, γ) CROSS SECTIONS AT 14 DIVIDED BY 15 MeV
G. Longo and F. Saporetti 1968 10 p refs
(RT/FI(68)42) Avail: CFSTI

An empirical expression relating the (n,γ) cross section to the parameter $(N-Z)^2/A$ is proposed. If confirmed by new experiments, this relation may indicate some fundamental aspect of the (n,γ) reaction not reflected by the present models. Author

N69-20186# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
CONTRIBUTION TO THE STUDY OF DEFORMED HEAVY NUCLEI BY MEANS OF NUCLEAR REACTIONS CONTRIBUTION A L'ETUDE DES NOYAUX LOURDS DEFORMES AU MOYEN DE REACTIONS NUCLEAIRES]
Jean Gastebois (Ph.D. Thesis—Paris Univ.) Sep. 1968 94 p refs
In FRENCH; ENGLISH summary
(CEA-R-3571) Avail: CFSTI

The experimental results from a study of (d,p) reactions, at E_d = 12 MeV, on the three even-even deformed nuclei ^{170}Yb, ^{172}Yb and ^{174}Yb have been analysed in terms of DWBA calculations. Spectroscopic data concerning the odd final nuclei have been compared with the predictions of the collective model and Nilsson's model and the effect of various parameters used in the DWBA analysis (form factors, optical wave functions) has been carefully studied. The observed differences between the three final nuclei are qualitatively reproduced in the experimental study of resonances, seen in excitation functions of elastically and inelastically scattered protons on the same target nuclei, and corresponding to analogue states in the three nuclei ^{171}Lu, ^{173}Lu and ^{175}Lu. Author (ESRO)

N69-20190# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
DEVELOPMENT OF A SLOW MONO-KINETIC ELECTRON SOURCE [ETUDE ET REALISATION D'UNE SOURCE D'ELECTRONS LENTS MONOCINETIQUES]
Yves Ballu (Ph.D. Thesis—Paris Univ.) Dec. 1968 113 p refs
In FRENCH; ENGLISH summary
(CEA-R-3646) Avail: CFSTI

A comparative study of already existing slow mono-kinetic electron guns shows that those using a 127° electrostatic selector can be improved still further to arrive at the performances obtained with spherical 180° selectors. For this reason the 127° selector has been examined theoretically in more detail. It appears that it should be possible to obtain a resolving power better than 30 mV for a current of about 10^{-10} A, on condition that certain improvements are made to the instrument as normally designed particularly the entrance and exit slides. As a result, the usual suppressors for the scattered electrons are no longer necessary. The development of this apparatus has been carried out with particular care and the dimensional characteristics have been fixed to an accuracy of a few microns, although the instrument can be baked out at 300°C. The experimental results are in excellent agreement with the theoretical predictions and for a current of 10^{-10}A, the measured resolving power is 24±4 mV. The easy detection of the He resonance line at 19.3 eV has confirmed the advantages of this apparatus for the study of atomic collisions. Author (ESRO)

N69-20197 European Organization for Nuclear Research, Geneva (Switzerland). Synchro-cyclotron Machine Div.
STUDY OF THE REACTION POSITIVE PION PLUS DEUTERON YIELDS PROTON PLUS PROTON FOR PION ENERGY RANGE BETWEEN 143 AND 284 MeV [ETUDE DE LA REACTION POSITIVE PION PLUS DEUTERON YIELDS PROTON PLUS PROTON POUR DES PIONS D'ENERGIE COMPRISE ENTRE 143 ET 284 MeV]
C. Richard-Serre 2 Dec. 1968 92 p refs In FRENCH; ENGLISH summary
(CERN-68-40) Avail: Issuing Activity

The differential cross section was measured for pion laboratory energies of 143, 165, 188, 232, and 284 MeV, which is equivalent, for the inverse reaction ($p + p \rightarrow \pi^+ + d$), to proton laboratory energies of 572, 616, 662, 750, and 815 MeV. Pions produced in a CH_2 target by the external proton beam are directed onto a liquid deuterium target. The two outgoing protons are detected in coincidence, and the energy of the backward-going proton is measured by a 8" diameter, 8" long sodium iodide crystal. The correction for the nuclear interactions in the NaI crystal was calculated and compared to experimental data. The composition of the beam was determined by a Cerenkov counter and corrections applied to the results. The cross-sections in the centre of mass are fitted to the relation: $d\sigma/\Omega = K(A + \cos^2\vartheta - B\cos^4\vartheta)$. The total cross sections are illustrated and exhibit the well-known peak which is located at a proton energy of 615 MeV for the reaction ($p + p \rightarrow \pi^+ + d$). The results are compared with various models: the phenomenological model of Gell-Mann and Watson, the Mandelstam model and the isobar calculations of Tran. None of these models is found to give a completely satisfactory explanation of all the experimental data, although the major features of the reaction seem to be well understood. Author

N69-20208# General Physics Corp., Ellicott City, Md.
APPLICATION OF MODIFIED ENGINEERING METHOD TECHNIQUES TO SKYSHINE RADIATION MEASUREMENTS Final Report
Alvin L. Jenkins and David E. Hinkley Nov. 1968 56 p refs
(Contract DAAA15-67-C-0589)
(AD-681231; NDL-TR-117) Avail: CFSTI CSCL 18/8

The results of US Army Nuclear Defense Laboratory (USANDL) skyshine reduction factor measurements for open and concrete-covered basements are compared with theoretical reduction factor formulations. New empirical procedures are developed within the engineering method format to improve the agreement between theory and experiment. In the covered basement cases, a new geometry factor is developed which includes the effects of scattered and unscattered radiation in the basement cover. In addition to the modified engineering method techniques developed for calculating skyshine reduction factors, a new method of calculating far field corrections is developed for experiments measuring skyshine exposure rates in open and covered basements. While the new method does not give corrections which differ significantly from other methods, it permits an estimate of the standard error in the far field correction and is less sensitive to the exposure rate measured for the outermost experimental annulus used in the USANDL experiments. Author (TAB)

N69-20216# Avco-Everett Research Lab., Everett, Mass.
EXPERIMENTAL DETERMINATION OF THE CROSS SECTIONS FOR NEUTRAL BREMSSTRAHLUNG. 1. He, Ar, AND Xe
Raymond L. Taylor and George Caledonia Nov. 1968 56 p refs
(Contract F04701-68-C-0036)
(AD-681158; SAMSO-TR-68-386; AERL-RR-311) Avail: CFSTI CSCL 20/8

Experimental measurements of the cross sections for radiative scattering of electrons from the neutral species Ne, Ar and Xe have been obtained. The experiments were performed in shock-heated gases from 8000-15,000 degrees K using a rapid scanning spectrometer to measure the absolute intensity of the neutral Bremsstrahlung continuum over the wavelength interval of 2.0 - 5.4 microns in the infrared. The data have been analyzed to obtain the effective nuclear charge squared (Z sub i) squared, of the species i, doing the scattering using a modified form of the Kramers-Unsold equation, and to obtain the radiative absorption cross section Qa sub i. Experimental information on the temperature and wavelength dependence of the neutral Bremsstrahlung has been determined. The experimental Qas have been compared with calculations based on a simple theory of radiative scattering of electrons from neutral species. Author (TAB)

N69-20217# Avco-Everett Research Lab., Everett, Mass.
EXPERIMENTAL DETERMINATION OF THE CROSS SECTIONS FOR NEUTRAL BREMSSTRAHLUNG. 2. HIGH TEMPERATURE AIR SPECIES: O, N, AND NITROGEN GAS
Raymond L. Taylor and George Caledonia Nov. 1968 39 p refs
(Contract F04701-68-C-0036)
(AD-681159; AERL-RR-312; SAMSO-TR-68-375) Avail: CFSTI CSCL 20/8

The low energy cross sections for neutral Bremsstrahlung for the major species of high temperature Air-O, N, and N2 have been measured. The experiments were performed behind reflected shocks by measuring the absolute, infrared intensity of appropriate shock heated gas mixtures. The radiation was detected with a rapid scanning infrared spectrometer covering a total spectral range of 2.0 - 5.4 microns. The data were analyzed by assuming that the observed continuum was due to free-free scattering of electrons from the neutral species in the gas studied. The neutral Bremsstrahlung cross section was determined for (1) atomic oxygen in O2-Ne mixtures, (2) atomic nitrogen in N2-Ne mixtures, and (3) for molecular nitrogen from data on pure N2. Further checks on the experimental values were obtained by comparing the measured cross sections against intensity data from air and N2-Ar and N2-Ne mixtures. The data were analyzed for the effective nuclear charge squared and radiation absorption cross section of the active species. The data are compared with previous experimental measurements and with theoretical calculations. Author (TAB)

N69-20225# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Reaktorzentrum.
AN ELECTROSTATIC SPECTROMETER FOR MEASURING THE PROTON RECOIL SPECTRUM IN NEUTRON BETA DECAY [ENTWICKLUNG EINES ELEKTROSTATISCHEN KUGELKONDENSATOR-SPEKTROMETERS ZUR MESSUNG DES RUCKSTOB-PROTONENSPEKTRUMS BEIM B-ZERFALL DES NEUTRONS]
Werner Kubischta (Ph.D. Thesis—Tech. Hochschule in Wien) Jun. 1968 80 p refs In GERMAN; ENGLISH summary
(Contract AF 61(052)-857)
(AD-680817; AFOSR-69-0039TR) Avail: CFSTI CSCL 18/4

This report describes part of the work for an experiment on neutron decay, in which the coefficient of the electron-antineutrino angular correlation is to be determined from a precise measurement of the shape of the proton recoil spectrum. Since a resolution 2 percent and a small entrance aperture for the adjacent detector was required and in view of the low proton energy (762.34 eV maximum), the time-of-flight spectrometer was chosen. Numerical methods were used to determine the smallest possible condensor dimensions, considering the large cross section (38 mm) of the entering proton beam, and taking the fringing field into account. The mesh method was used to calculate the potential near the electrode edges, and the Runge-Kutta-method was used to calculate particle orbits. The minimum central particle orbit necessary is shown to be 300 mm. A hydrogen ion source, consisting of an electron impact source and a Wien-filter, has been used to test the spectrometer. Excellent agreement between measured and calculated particle orbits was found. TAB

N69-20245 Purdue Univ., Lafayette, Ind.
THE FADDEEU EQUATIONS IN HELICITY EIGENSTATES WITH AN APPLICATION TO PI-d SCATTERING
Gary Dean Doolen (Ph.D. Thesis) 1968 124 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-12544

The exact three-particle Schrödinger equation for the scattering of one particle from a bound state of the other two particles is written in terms of three-particle helicity states using the Faddeev form of the equations. These equations are convenient for including any two-body partial-wave amplitude and the effects of spin. These non-relativistic equations are applied to a separable potential model for π-d scattering in which the π-N amplitude is allowed to resonate in a p-wave similar to the $N^*(1238)$. The computer solution of the equations obtained indicates that multiple scattering effects are small but not negligible. A comparison is made of the exact single scattering amplitude and the impulse approximation amplitude. The upper bound for the number of binary collisions of point particles allowed by energy and momentum conservation is obtained. The relationship of classical collisions to the rescattering singularities is discussed. Dissert. Abstr.

N69-20280# Commissariat à l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucléaires.
RADIOCHEMICAL SEPARATIONS OF HAFNIUM, TANTALUM AND GERMANIUM FROM TUNGSTEN AND SELENIUM IRRADIATED BY 14 MeV NEUTRONS [SEPARATIONS RADIOCHIMIQUES DE HAFNIUM, TANTALE ET GERMANIUM A PARTIR DE TUNGSTENE ET DE SELENIUM IRRADIES APR PAR NEUTRONS DE 14 MeV]
Jean Blachot, Abderrahmane Benabed, Jacques Herment, and Edouard Monnand Dec. 1968 13 p refs In FRENCH; ENGLISH summary
(CEA-R-3678) Avail: CFSTI

Radiochemical separations of Hf, Ta and Ge from W and Se respectively, after 14 MeV -neutron irradiation. A new isotope : ^{79}Ge with a half-life of 50 ± 5 s and an emitter of a 230 keV γ transition is observed. Author (ESRO)

N69-20282 New York Univ., N. Y.
THE ISOTOPE SHIFT IN Bi 206
Peter Carmine Magnante (Ph.D. Thesis) 1968 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-13133

The optical spectra of Bi^{209} (10^{18}y) and Bi^{208} (6.3d) were measured using a high-resolution Czerny–Turner spectrograph having a 30 foot focal length. The Bi^{206} was obtained at the Harvard cyclotron by a Pb^{208} (p,3n) reaction. A radiochemical procedure was developed for separating the radioactive bismuth from the lead target and transferring it into an electrodeless lamp. From an analysis of the hyperfine structure patterns, a value of 123 ± 13 mK was obtained for the isotope shift of the 3067A resonance line for the Bi^{209},Bi^{206} pair. Measurements in the 4722A line also were obtained but were considered unreliable because of the dense background spectrum. An interpretation of the measured isotope shift is given, and the importance of the odd proton in bismuth is discussed. The effect of the angularity

asymmetric distribution of the bismuth odd $h_{9/2}$ proton on the isotope shift may be greater than the effect of the thallium symmetric odd proton, which is known to be small. Dissert. Abstr.

N69-20349 Australian National Univ., Canberra. Research School of Physical Sciences.

DEUTERON INDUCED REACTIONS IN C 12 AT BOMBARDING ENERGIES OF 5 TO 10 MeV

H. Cords, G. U. Din, and B. A. Robson [1968] 63 p refs

(ANU-P/432) Avail: Issuing Activity

Absolute differential cross sections for the reactions $^{12}C(d,p)^{13}C$ leading to the ground state and the 3.09, 3.68 and 3.85 MeV excited states, $^{12}C(d,\alpha)^{10}B$ for the ground state and 0.717 MeV residual level and the elastic scattering of deuterons on ^{12}C were measured for bombarding energies of 5 to 10 MeV. An analysis of these measurements was performed using the optical model and the distorted-wave and Hauser–Feshbach theories. Author

N69-20356# Southern Illinois Univ., Carbondale. Materials Science Lab.

SYMMETRY-FACTOR MAPS: COMPUTING PROGRAMS AND DICHROMATIC SYMMETRY Interim Report

Marisa Canut-Amoros, Mark Mabee, and Jose Luis Amoros Nov. 1968 114 p *Its* Mat. Sci. Lab.-2

(Grant AF-AFOSR-832-67)

(AD-681196; AFOSR-69-0099TR) Avail: CFSTI CSCL 20/2

The structure-factor is a trigonometrical expression that represents the resultant effect of the wave scattered by the atoms of a unit cell. Crystal-structure analysis is based on finding the best fitting of the atomic coordinates of atoms of a given scattering power to give the best values of the calculated amplitudes in relation to the observed intensities. The form of the trigonometrical expression depends upon the symmetry of the crystal structure; that is, it depends on the geometrical distribution of atoms equivalent by symmetry, i.e., the equipoint of an atom in the unit cell. The contribution of an atom in the position (x, y, z) depends then upon those coordinates and the equipoint determined by the symmetry elements of the space group. Two programs, SFM-symmetry-factor mapping, and SFMPLT - symmetry-factor map plot, have been developed to calculate and plot the function for given combination of h, k. The resulting maps show dichromatic symmetry that is systematically studied. Author (TAB)

N69-20382# Junta de Energia Nuclear, Madrid (Spain).

THE FRAGMENTATION OF HEAVY NUCLEI BY 13.8 GeV/c PROTONS AS A CONTRIBUTION TO THE STUDY OF THE INTERACTION MECHANISM AND NUCLEAR STRUCTURE [FRAGMENTACION DE NUCLEOS PESADOS POR PROTONES DE 13.8 GeV/c, COMO CONTRIBUCION AL ESTUDIO DEL MECANISMO DE INTERACCION Y ESTRUCTURA NUCLEAR]

Daniel Gil Pérez 1967 22 p refs In SPANISH; ENGLISH summary

(JEN-195-IFIC/159) Avail: CFSTI

A global study of the interaction between high-energy particles and heavy nuclei is presented, an interaction which holds obvious interest in relation to the problems of nuclear fragmentation and which, up to now has only been studied piecemeal. Three stacks of photographic emulsions which were irradiated by 13.8 GeV/c protons, 17 GeV/c negative pions and 24 GeV/c protons, were used. All three irradiations took place in a 180 K.G. magnetic field using CERN beams. A complete phenomenological study of all the tracks due to secondary or fragment emission following interaction between the incoming particle and the heavy nuclei (Ag and Br) of the emulsion is presented. Measurements of emission angle and energy as well as the classification of all particles by charge are given. An original method for the discrimination of recoils is explained. The energy spectra and angular distribution obtained have enabled the separation experimentally of groups of fragments corresponding to the two distinct emission mechanisms, evaporation and cascade, for particles of any charge including charge-one particles. Some of the many consequences of this experimental separation into particles emitted by either mechanism are investigated. One of the most important results is the reduction of the nuclear temperature achieved using the Fermi model for the particles which correspond to the evaporation phase only. Author (ESRO)

N69-20484# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).

SLOW NEUTRON RESONANCES IN PALLADIUM ISOTOPES

C. Coceva, F. Corvi, P. Giacobbe, and M. Stefanon 1968 9 p refs Presented at the Intern. Conf. on the Study Nucl. Struct. with Neutrons, Antwerp, 19–23 Jul. 1965

(RT/FI(68)37) Avail: CFSTI

The Ispra fast chopper was used for transmission measurements on small samples of separated isotopes Pd 105 and Pd 108. The disposition of the neutron source and the neutron flux vs. time of flight at the detector are shown in this paper. Four lithium glass scintillators were used as detectors. Use of the separated isotopes permitted the analysis of resonances up to 90 eV; in some cases, the values obtained with natural palladium were improved. The best set of parameters obtained by analyzing both natural and enriched palladium transmission measurements are presented in tables. With the results from Pd 105, the S wave strength function was calculated for the resonances of each spin state. The neutron widths were also measured. K.W.

N69-20564# Australian National Univ., Canberra. Dept. of Nuclear Physics.

THE AUSTRALIAN NATIONAL UNIVERSITY, DEPARTMENT OF NUCLEAR PHYSICS, ANNUAL REPORT, 1968

E. W. Titterton Jan. 1969 47 p refs

(ANU-P/434; REPT-14/1969) Avail: CFSTI

Summaries are presented of research programs employing target materials of a wide range of masses throughout the periodic table and using as bombarding particles protons, deuterons, He^3, He^4, and O^{16}. The status and operation of research equipment are briefly discussed, including a tandem accelerator, a 2–MeV accelerator, computers and computer programs, detector systems, shielding systems, and supporting electronics. Publications and lectures of the year are also listed. K.W.

N69-20558# Technische Hogeschool, Eindhoven (Netherlands).

PERTURBATION THEORY FOR INTERMOLECULAR FORCES. APPLICATION TO SOME ADSORPTION MODELS

Adrianus van der Avoird (Ph.D. Thesis) Rotterdam 1968 163 p refs

Avail: CFSTI

A perturbation theory for calculating the interactions between atoms or molecules is developed and numerically tested by calculating the interaction energy for the two lowest states of the hydrogen molecule ion. This is followed by the application of the theory to some models for adsorption on transition metals. In the theoretical part, mathematical techniques usually used in quantum mechanics are employed, including operator algebra, group theory, and Dirac's bracket notation. The model calculations are performed to determine the affects of localized unpaired d-electrons on the adsorption on the transition metals, i.e., the interaction energy between the adsorbate (a rare gas atom or a hydrogen molecule) and the metal surface. K.W.

N69-20622# International Centre for Theoretical Physics, Trieste (Italy).
GLAUBER THEORY AND π-d SCATTERING IN THE GeV REGION
G. Alberi (Trieste Univ.) and L. Bertocchi Oct. 1968 15 p refs Submitted for publication Sponsored by Ist. Nazl. di Fis. Nucl.
(IC-68-98) Avail: CFSTI

The Glauber theory, which in principle does not hold for low energy interactions implying large scattering angles, a marked spin-dependence of the π-N scattering amplitude and also a rapid variation with energy of the scattering amplitude due to the experiments being performed in the 'resonance region', is being generalized here to include spin variables for π-d scattering. The results are compared with existing experiments. ESRO

N69-20624# International Centre for Theoretical Physics, Trieste (Italy).
ON THE EXISTENCE OF THE μ-MESON
A. O. Barut Oct. 1968 8 p refs Submitted for publication
(Grant AF-AFOSR-30-67)
(IC-68-59) Avail: CFSTI

It is proposed that the leptonic matter distribution is not equal to the distribution of electric charge and that it contains the distribution of other (e.g. weak) charges. On this basis the occurrence of the μ-meson is natural and a theory of the e-μ system is constructed. Author (ESRO)

N69-20625# International Centre for Theoretical Physics, Trieste (Italy).
GLAUBER SHADOW AND INELASTIC CONTRIBUTIONS TO πd SCATTERING
G. Alberi (Trieste Univ.) and L. Bertocchi Nov. 1968 21 p refs Submitted for publication Supported in part by the Ist. Nazl. di Fis. Nucl.
(IC-68-99) Avail: CFSTI

The contribution of inelastic intermediate states in the elastic πd scattering is estimated using a Regge pole model. It is shown that this effect can fill the dip which otherwise should be present in the differential cross-section. Author (ESRO)

N69-20635# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
STUDY OF THE TEMPORARY CAPTURE OF AN ELECTRON BEAM IN MAGNETIC MIRROR CONFIGURATION [ETUDE DE LA CAPTURE TEMPORAIRE D'UN FAISCEAU D'ELECTRONS DANS UNE CONFIGURATION MAGNETIQUE A MIROIRS]
Jean-Jacques Gourdon (Ph.D. Thesis) Dec. 1968 88 p refs In FRENCH; ENGLISH summary Sponsored in part by EURATOM
(CEA-R-35568; EUR-3870-f) Avail: CFSTI

A method of injection is studied which is intermediate between the purely transverse injection used in MMII and the longitudinal injection used in CAPEL. The investigation of the conditions of injection of an electron beam has shown the possibility of temporarily capturing a beam approximately 1 cm in width. The mean length of the captured trajectories is about fifty meters and a uniform perturbation of the magnetic field which destroys the axial symmetry does not appreciably modify this length. This method of injection, called 'conical', is interesting because about 80 per cent of the injected beam is captured and it takes place with injection conditions that are not critical. Author (ESRO)

N69-20672# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
PHENOMENOLOGICAL AND MICROSCOPIC ANALYSIS OF PROPERTIES OF EVEN-EVEN NUCLEI
C. A. Heras (Oriente Univ.), S. M. Abecasis (Inst. de Investigacion Aeron. y Espacial), and H. E. Bosch (Inst. de Investigacion Aeron. y Espacial) May 1968 436 p refs
(NP-17506) Avail: CFSTI

CONTENTS:
1. PHENOMENOLOGICAL MODELS p 1-125 refs (See N69-20673 09-24)
2. COLLECTIVE BEHAVIOUR FROM PARTICLE DYNAMICS p 127-189 refs (See N69-20674 09-24)
3. MICROSCOPIC MODELS p 191-421 refs (See N69-20675 09-24)

N69-20673# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
PHENOMENOLOGICAL MODELS
In its Phenomenological and Microscopic Anal. of Properties of Even-Even Nuclei May 1968 p 1-125 refs (See N69-20672 09-24)
Avail: CFSTI

General features of several phenomenological nuclear models are described in a manner especially suited for experimentalists. Special attention is given to the unified nuclear model, weak and intermediate coupling limit, strong coupling limit, asymmetric rotor model, refinements of Davydov-Filippov model, general asymmetric rotor model, and odd-parity excitations. The following types of spectra are mentioned: (1) Spectra characterized by ratios of energy of excited states and character of excited states corresponding to closed proton and/or neutron shells. (2) Spectra in which the character of the first excited state is 2+. (3) Spectra characterized by the existence of bands of levels each with the following sequences having approximately rotational spacings (0+, 2+, 4+, ... beginning at the ground state; 0+, 2+, 4+ ... beginning at the 0+ excited state; and 2+, 3+, 4+ ... beginning at a 2+ excited state not contained in the previous bands). (4) Spectra that exhibit relatively low lying negative parity states. B.P.

N69-20674# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
COLLECTIVE BEHAVIOR FROM PARTICLE DYNAMICS
In its Phenomenological and Microscopic Anal. of Properties of Even-Even Nuclei May 1968 p 127-189 refs (See N69-20672 09-24)
Avail: CFSTI

Deformed well independent models and cranking models are described which are used to determine the parameters of the phenomenological models from particle dynamics. In addition, some attempts to obtain collective coordinates from particle coordinates are briefly described. The qualification "collective" is used in a hydrodynamic sense, i.e., the particles lose their individuality. It was shown that a rigorous treatment of collective motions of a finite system of interacting particles is extremely difficult in the nuclear case. Four methods were involved in describing or allowing numerical calculations of collective motions: variational generator coordinate, Hartree-Fock, Peierls-Thouless version of the variational generator coordinate method, and the Skyrme-Levinson variational method. B.P.

N69-20675# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
MICROSCOPIC MODELS

In its Phenomenological and Microscopic Anal. of Properties of Even–Even Nuclei May 1968 p 191–421 refs (See N69-20672 09-24)
Avail: CFSTI

A system of microscopic models is described to aid in finding a connection between the parameters of the two nucleon system and the behavior of the composite nuclei. In the development of the theory of many body systems, it was found convenient to use a representation of wave functions and operators in terms of creation of annihilation operators. The main features of this representation are briefly described because of its common use in microscopic models. Methods of dealing with interacting particles are classified and include: residual interaction, methods of group theory, particle hole interaction, and interacting quasiparticle picture. The methods outlined were applied to interpret experimental data on the states arising from two quasiparticle excitations. B.P.

N69-20685# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
PHYSICS DIVISION Progress Report, 1 Oct.–31 Dec. 1968
31 Dec. 1968 86 p refs
(AECL-3257) Avail: Atomic Energy of Can., Ltd., Chalk River $2.00

A report on developments in the physics division is presented. Areas covered include: (1) nuclear physics, (2) general physics; (3) neutron physics; (4) theoretical physics, and (5) mathematics and computation. F.O.S.

N69-20697 National Bureau of Standards, Washington, D. C. Polymers Div.
TABLES OF SOLUTIONS TO BRAGG'S EQUATION FOR COPPER, COBALT, IRON, AND CHROMIUM KA RADIATION AND SMALL DIFFRACTION ANGLES
James P. Colson and Edward S. Clark (Du Pont De Nemours /E. I./ and Co., Wilmington, Del.) Aug. 1968 76 p refs
(NBS-TN-461) Avail: SOD $0.50

Bragg's equation solutions are presented for the K radiation of Cu (1.541838 A°), Co (1.790260 A°), Fe (1.937355), and Cr (2.291002 A°). The value of 2 theta is increased in increments of 0.001 degree from 0.001 to 2.999 degrees and in increments of 0.00001 radian from 0.00002 to 0.04999 radian. The solutions are rounded off to five digits. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N69-19748# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
A NEW TEMPERATURE EFFECT IN IONIZED MEDIA IN THE PRESENCE OF HEAVY NEGATIVE ELECTRICAL CHARGES [SUR UN NOUVEL EFFET DE TEMPERATURE DANS DES MILIEUX IONISES EN PRESENCE DE CHARGES ELECTRIQUES NEGATIVES LOURDES]
Siegfried Klein (Ph.D. Thesis—Paris Univ., 8 Dec. 1967) May 1968 81 p refs In FRENCH; ENGLISH summary
(CEA-R-3437) Avail: CFSTI

A relatively large electromotive force arises in ionized vapors between two electrodes having different temperatures. This phenomenon is interpreted on the one hand in terms of the massive formations of heavy negative electrical charges near the 'cold' electrode and on the other hand, in the case of flames, on the existence of an electronic temperature much higher than that predicted by conventional theory. This temperature effect makes it possible to convert the ionizing energy directly into electricity. Author (ESRO)

N69-19773# Los Alamos Scientific Lab., N. Mex.
EQUILIBRIUM OF A PLASMA OF FINITE PRESSURE IN A STRAIGHT STELLARATOR
G. E. Vekshtein [1968] 10 p refs Transl. into ENGLISH from Russian Preprint
(LA-tr-68-43) Avail: CFSTI

The equilibrium of a plasma of finite pressure in a three-turn helical magnetic field and its effect on the integral characteristics of confinement (volume per unit flux V', rotational transform) are considered. It is shown that even at $\beta_0 << 1$ they can differ considerably from those for a vacuum. Author (NSA)

N69-19783*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
POSSIBLE APPLICATIONS OF THE CONTINUITY-EQUATION PLASMA OSCILLATION TO PULSARS AND OTHER PERIODIC ASTROPHYSICAL PHENOMENA
J. Reece Roth Washington Mar. 1969 60 p refs
(NASA-TN-D-5078) Avail: CFSTI CSCL 03B

The continuity equations for neutral and charged particles in a partly ionized gas may possess periodic solutions. These oscillations are suggested as a possible clock mechanism for periodic astrophysical phenomena such as geomagnetic micropulsations, pulsars, and of long-period fluctuatins in the charged particle density of the interstellar medium. A mathematical model of these oscillations is derived and applied to two cases of astrophysical interest; an isolated, virtually uniform region of partially ionized gas; and a slightly ionized stellar or planetary atmosphere, the characteristics of which vary with position. The theoretical analysis is supplemented by an experimental investigation of the pulsed production and loss of electrons from a magnetically confined laboratory plasma which was subject to the continuity-equation oscillation. Some pulsar like characteristics were observed and measured in this plasma. Author

N69-19816# Commissariat a l'Energie Atomique, Paris (France).
OSCILLATOR FORCES AND PROFILES OF THE SPECTRAL LINES OF CESIUM IN A PLASMA [FORCES OSCILLATEURS ET PROFILS DES RAIES SPECTRALES DU CESIUM DANS UN PLASMA]
S. M. Gridneva and G. A. Kassbov 3 Sep. 1968 13 p refs In FRENCH Presented at the 7th Intern. Conf. on Phenomena in Ionized Gases, Belgrade, 22–27 Aug. 1965
(CEA-tr-R-1939; CONF-650806-27) Avail: CFSTI

Measurements were made of the absolute oscillator strengths from the spectral lines of cesium in an argon–cesium mixture in a positive column discharge. The results show a broadening and displacement of the spectra lines. They show good comparison with theoretical results. Author (NSA)

N69-19881*# National Aeronautics and Space Administration, Washington, D. C.
METHODS OF HIGH-SPEED MEASUREMENTS IN GAS DYNAMICS AND PLASMA PHYSICS
Yu. Ye. Nesterikhin et al Sep. 1968 183 p refs Transl. into ENGLISH of the book "Metody Skorostnykh Izmereniy v Gazodinamike i Fizike Plasma" Moscow, Nauka Press., 1967 p 1–172
(NASA-TT-F-12202) Avail: CFSTI CSCL 20I

Methods are described which can be used for quick-response measurement of velocity, density, temperature, pressure, concentration, magnetic and electric field intensity, etc., in shock tubes and plasma injectors, devices for rapid compression of ionized gases with magnetic fields, and other pulse-excited gas dynamics and plasma devices. Various methods of obtaining shock waves, high-speed gas streams, and high temperature plasma are briefly analyzed. Methods for observing high velocity gas flows are examined in detail, as are various procedures for quantitative measurements of the density of the neutral particles and electrons. Spectroscopic methods of temperature and concentration measurements and time-resolved mass spectroscopy in pulse-excited plasma generators are also discussed. This book is intended for experimental physicists and for undergraduate and graduate students specializing in the fields of gas dynamics and plasma physics. Author

N69-19955 Delaware Univ., Newark.
THE SPATIAL DISTRIBUTION FUNCTION IN AN ANISOTROPIC PLASMA
Louis Edward Roemer (Ph.D. Thesis) 1967 106 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-13165

The spatial distribution is function is described for electrons contained in an axial magnetic field and excited by microwave electromagnetic waves. A perturbation solution for the distribution function is obtained and shown to be consistent with experimental observations. In addition, the behavior of a resonance due to depolarization is discussed in relation to multiple effective cyclotron resonances in the plasma. The multiple resonances have been reported by earlier investigators, but not heretofore explained. Measurements of radial electron density were made and appear consistent with the perturbation theory. The variation of electron density with magnetic field is consistent with the assumed model. Dissert. Abstr.

N69-19992 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
PLASMA PHYSICS
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 69–82 refs (See N69-19981 09-34)
(Contract AT(30-1)-1842)
Avail: CFSTI

The average mobility, frequency of collision for momentum transfer, and mean-free path for electrons with Maxwellian energy distribution in argon have been computed as functions of electron temperature Wave-particle interaction analyses for magnetic fields showed that the distribution function to any order in perturbation theory obeys a diffusion equation. Theoretical analysis on harmonic generation in the radio frequency signal of a plasma resonance probe showed that the voltage of the harmonic was proportional to the fundamental voltage to the power of the harmonic number. G.G.

N69-19994 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
PLASMAS AND CONTROLLED NUCLEAR FUSION
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 85–133 refs (See N69-19981 09-34)
(Grant NSF GK-2581)
Avail: CFSTI

Active plasma systems were studied by spectroscopic measurements on ion temperature, electrostatic plasma probes signals, interactions of spiraling electron beam with plasma, and the stability of electron beams with velocity shear. Active plasma effects in solids were observed by microwave instabilities in indium antimonides placed into magnetic fields as well as by collision induced instabilities in helicon waves and helicon propagation in semiconducting structures. G.G.

N69-19995 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
SPONTANEOUS RADIOFREQUENCY EMISSION FROM HOT-ELECTRON PLASMAS
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 135–144 refs (See N69-19981 09-34)
(Contract AT(30-1)-3581)
Avail: CFSTI

We are continuing the study of the intense instability occurring in the afterflow of a pulsed electron-cyclotron resonance discharge. In this report we enlarge upon the radiation measurements presented previously, interpret the density evolution of the plasma in terms of a simple model, and present a comparison between a number of the basic characteristics of the discharge. Author

N69-19996 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
INTERACTION OF LASER RADIATION WITH PLASMAS AND NONADIABATIC MOTION OF PARTICLES IN MAGNETIC FIELDS
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 145–158 refs (See N69-19981 09-34)
(Contract AT(30-1)-3285)
Avail: CFSTI

Here we apply Dupree's strong turbulence theory to wave-particle interaction in a transverse electromagnetic wave propagating parallel to an external magnetic field. By using a transformation of the velocity coordinate, which is essentially transformation to the wave frame used in studies of the single-particle motion, we reduce the Vlasov equation to a one-dimensional diffusion-type equation. Then manipulation similar to that of the longitudinal wave case by Dupree leads to nonlinear wave-particle interaction including "trapped" particle effects. We compare the results in the strong field limit, where the trapping effect is important, with the results of the single-particle model. The results agree except for numerical factors. The single-particle calculation gives a proof of the correctness of the strong turbulence theory, which includes some crucial assumptions and provides some clearer physical intuitions. Author

N69-20010# Gulf General Atomic, San Diego, Calif.
PLASMA INSTABILITIES IN GULF GENERAL ATOMIC MULTIPOLE DEVICES
T. Ohkawa, M. Yoshikawa, and A. A. Schupp 29 Apr. 1968 14 p refs Presented at the 3d Intern. Atomic Energy Agency Conf. on Plasma Phys. and Controlled Nucl. Fission Res., Novosibirsk, USSR, 1–7 Aug. 1968
(Contract AT(04-3)-167)
(GA-8669; CONF-680805-23) Avail: CFSTI

The plasma instabilities are studied in both the octopole and quadrupole configurations. A typical set of parameters is plasma density 10^{10} cm^{-3}, ion temperature 100eV, and electron temperature 10 eV. In both devices the difference of the vector potential between the separatrix and the wall or the stability limit corresponds to about five gyroradii for 100-eV hydrogen ions. In the octopole configuration, three types of fluctuations are recognized. The first type of fluctuation has a zero wave number parallel to the magnetic field and propagates along the diamagnetic current with a wave number comparable to the reciprocal of the ion gyro-radius. The second type is observed at the plasma density below 3×10^{8} cm^{-3} with a toroidal field larger than 40 G.

The third type is observed in the plasma with a density below 3 × 10^8 cm^3 only when the ion temperature is lowered. Large-amplitude (20%) fluctuations are found inside the stability limit in the quadrupole device. Author (NSA)

N69-20034# Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
PERSPECTIVES ON CONTROLLED THERMONUCLEAR RESEARCH: A REPORT ON THE THIRD IAEA CONFERENCE AT NOVUOSIBIRSK, AUGUST 1968
Robert L. Hirsch, ed. Oct. 1968 125 p refs
(TID-24804) Avail: CFSTI

Summaries on the state of progress of CTR are given for the following: (1) low β toroidal systems, (2) low β open systems, (3) high β compression systems, (4) Astron, (5) laser plasma and laser focus, (6) plasma heating techniques, (7) collisionless shock waves, (8) basic plasma physics and gas bounded plasma, (9) computer simulation and general plasma theory, and (10) technological problems of controlled thermonuclear power. NSA

N69-20078 Florida Univ., Gainesville.
THE THEORY AND THE DIAGNOSIS OF THE ELECTRODELESS DISCHARGE
Dennis Ralph Keefer (Ph.D. Thesis) 1967 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-9530

An analysis of the asymmetric double probe is described which permits the measurement of electron temperature, electron number density and plasma potential in an electrodeless discharge. Experiments were performed which indicate that the electron temperature and ionization function are essentially uniform across the discharge radius. These results are at variance with commonly made assumptions concerning the discharge. An analysis of the energy transport in the discharge predicts that, due to the thermal conduction of the electron gas, the temperature is essentially uniform. The fact that the electron temperature is uniform is used as a basis for the formulation of a one-dimensional, steady-state theory for the inductively driven electrodeless discharge. An important result of the theory is the prediction that electron temperature is independent of the input power, and that the electron number density is a direct function of the solenoid coil current. Dissert. Abstr.

N69-20092 Missouri Univ., Columbia.
MAGNETIC FIELD EFFECTS ON LANDAU DAMPING
Gary Michel Babler (Ph.D. Thesis) 1968 186 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-12484

Studies were conducted on longitudinal electron oscillations in a nonrelativistic boundless, Maxwellian, collisionless magnetoplasm, in a formalism which allowed subsequent investigation of the coupling effects between the longitudinal and trasverse waves. For the uncoupled case, an explicit formula for the longitudinal component of the electric field was developed as a linear superposition of exponentially damped sinusoidal oscillations whose complex frequencies depend on the wavelength and the equilibrium state of the plasma through the dispersion relation. The location of the Landau zeros and the minimum time were studied as functions of several parameters, with the following results: (1) For the no external magnetic field case, or the physically equivalent case of wave propagation parallel to the magnetic field, the minimum time increases with increasing wavelength over a wide range of Debye lengths, increases with decreasing thermal spread of the initial perturbation when this spread is less than unity, and is unaffected for spreads greater than unity. (2) For strong external magnetic fields, the Landau zeros move continuously along rays from their location in the absence of a magnetic field to the origin as the angle θ between the propagation vector of the wave and the magnetic field approaches 90° and the minimum time increases without this same variation in angle θ. (3) As the strength of the magnetic field increases through the intermediate range the Landau zeros migrate in a "looping" fashion from their theoretically predicted no field locations to their strong field locations. The criterion for validity of the negligible-coupling approximation in a strong magnetic field was also studied. Dissert. Abstr.

N69-20152 Michigan Univ., Ann Arbor.
CONTINUOUS CROSS-MODULATION OF MICROWAVES IN A HELIUM PLASMA
Kenneth Dale Ware (Ph.D. Thesis) 1968 125 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-13425

The theoretical analysis is extended to include effects arising from the dc conductivity, electron–ion collisions, and electron density variations, as well as those due to electron temperature variations. Due to the heating effect of a modulated disturbing microwave, all of these plasma properties are disturbed and can cause variations in a second sensing microwave. The analysis describes the relative importance of the properties in continuous cross-modulation. Measurements were made in a large volume (4 cu ft) helium glow discharge with 10 cm microwaves. In this case, cross-modulation depended primarily on electron density variations. Using independent measurements of electron temperature and density, the transferred modulation depth led to a value for the probability of collision for electron momentum transfer, P_m (18.7 ± 2.1 cm^{-1} $Torr^{-1}$ at 0°C), and to a value for the electron–ion recombination coefficient, α_e (3.6 ± 2.2 × 10^{-8} cm^3 sec^{-1}). These quantities are in good agreement with other published values. Dissert. Abstr.

N69-20220# Northwestern Univ., Evanston, Ill. Gas Dynamics Lab.
SHOCK WAVE INTERACTION STUDIES IN A DOUBLE ENDED OPPOSING DRIVER ELECTROMAGNETIC SHOCK TUBE
David A. Freiwald Jun. 1968 209 p refs
(Contract AF 49(638)-1533)
(AD-680834; AFOSR-69-0010TR) Avail: CFSTI CSCL 20/9

The head-on collisions of Mach 20 - 23 ionizing shock waves in argon at an initial pressure of 115 microns Hg were experimentally investigated. The shock wave collisions were created in a double-ended opposing driver electromagnetic shock tube. Shock wave speeds were obtained using photometric techniques. Plasma time-resolved atom and ion number densities and temperatures were obtained from spectroscopic analysis of emission radiation using a spectrograph equipped with a photoelectric attachment. Photographs of visible luminous phenomena associated with the incident shock waves and shock wave collisions were obtained with an image converter camera. The plasma behind the incident shock waves was found to be a mixture of driver and driven gas. Correlation of photographic and spectroscopic results for shock wave collisions indicated that reflected shock wave/incident shock wave boundary layer interaction occurred resulting in reflected shock wave bifurcation. Author (TAB)

N69-20230# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
MAGNETIC CAVITY DUE TO LINE CURRENTS IN A PLASMA
Tutomu Kambe Dec. 1968 16 p refs *Its* ISAS Rept., Vol. 33, No. 15 (ISAS-433) Avail: CFSTI

The shape of two-dimensional cavity formed in a plasma by the effect of the magnetic field due to several parallel line currents is discussed. A rigorous treatment based on the conformal transformation is given. The exact shape of the cavity is determined

for the case of two or four line currents and for their limiting cases which represent a magnetic dipole and quadrupole. The method is also applicable to more general cases. Author

N69-20297# National Aeronautical Lab., Bangalore (India).
SHOCK STRUCTURE IN A COLLISIONLESS PLASMA
K. S. Viswanathan Mar. 1968 14 p refs
(NAL-TN-10) Avail: CFSTI

The structure of the pressure tensor in a collision-free plasma is different from that in an ordinary conducting fluid, and this fact has been utilized to obtain the thickness of the shock front in a collisionless plasma, as for example, the shock produced by the magnetosphere in the solar plasma. Making use of the expressions for the pressure and heat transport tensors in the first order perturbation theory, a closed expression has been obtained for the thickness of the shock in a collision-free plasma. The shock thickness depends on the ordinary as well as the magnetic Mach numbers and is directly proportional to the ion Larmor radius. Author

N69-20350*# Princeton Univ., N. J. Guggenheim Aerospace Propulsion Labs.
PULSED ELECTROMAGNETIC GAS ACCELERATION Semiannual Progress Report, 1 Jul.–31 Dec. 1968
Robert G. Jahn and Woldemar F. von Jaskowsky Jan. 1969 130 p refs
(Grant NGL-31-001-005)
(NASA-CR-100386; REPT-634; SAPR-13) Avail: CFSTI CSCL 20I

Current sheets propagating in a parallel-plate accelerator are found to arrest their motion at an electrode insulator junction, and there to lapse into stable, quasi-steady discharges. Kerr-cell photography, magnetic and electric probing and terminal voltage measurements indicate that these stabilized discharges accelerate gas through themselves as long as gas from the prefilling of the discharge chamber is available, after which enhanced erosion of insulator and electrode material appears. The process of energy transfer from a pulse network to a propagating current sheet was studied experimentally and analytically in a linear pinch configuration. The structure of the current sheet in a similar pinch discharge was studied with a specialized high-speed piezoelectric pressure transducer, which determined profiles of both axial and radial pressure. The structure of the anode attachment portion of high-current discharges, and its effect on the overall voltage was studied. Laser techniques were extended to search for population inversions in the outflow plasma from the quasi-steady parallel-plate accelerator. Author

N69-20416# Columbia Univ., New York. Electronics Research Labs.
SPECTROSCOPIC RESEARCH ON A FREE BURNING ARGON ARC WITH FORCED FLUID CONVECTION
C. G. Stojanoff Nov. 1968 6 p refs
(Contract AF 49(638)-1395)
(AD-681190; AFOSR-69-0069TR) Avail: CFSTI CSCL 14/2

The forced fluid convection arc is used to generate a radial weight flow in the arc column by means of fluid injection via the cathodic boundary of the arc. The influence of gas velocity upon the profile and the magnitude of the arc temperature is demonstrated and explained. The opportunity for higher enthalpy production and temperatures is delineated in terms of this weight flow and the limiting conditions of extremely high velocity in the cathode boundary are defined. Author (TAB)

N69-20590# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FORBIDDEN TRANSITIONS INDUCED IN ATOMIC SYSTEMS BY HOMOGENEOUS AND INHOMOGENEOUS ELECTRIC INTERMOLECULAR FIELDS IN A PLASMA
L. I. Grechikhin 5 Apr. 1968 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 10, no. 4, 1966 p 232–235
(AD-680926; FTD-HT-23-1584-67) Avail: CFSTI CSCL 20/9

Consideration is given to transitions which are forbidden by the selection rules for electric dipole, electric quadrupole, magnetic dipole and similar transitions, which are produced in the plasma by the electric intermolecular field. The formulas for the transition probabilities and for the transition intensities are presented from various literature sources and the results of concrete calculations are presented for the intensity of the forbidden transitions in lithium, sodium, copper, and cesium. In the case of inhomogeneous electric fields, the results of the calculations are given for cesium only. Possible application of the results for diagnostic purposes is mentioned. Author (TAB)

N69-20636# Commissariat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.
PERTURBATION ANALYSIS OF CYCLOTRON RESONANCE IN THE ELECTROMAGNETIC FIELD OF A TE_{011} MODE [ANALYSE PAR PERTURBATION DE LA RESONANCE CYCLOTRONIQUE DANS LE CHAMP ELECTROMAGNETIQUE EN MODE TE_{011}]
Harry Dreicer May 1968 19 p refs In FRENCH; ENGLISH summary
(CEA-R-3277) Avail: CFSTI

Electron orbital motion under the combined action of a static magnetic field and an AC azimuthal electric field in a cylindrical TE_{011} mode is analyzed with help of a perturbation technique. The first and second order perturbation results indicate that at cyclotron resonance the electron's center of gyration oscillates slowly at right angles to the magnetic field between two turning points. Superimposed upon this nearly static $E \times B$ drift the electron cyclically undergoes the process of cyclotron absorption and induced emission. Maser action (i.e., induced emission rather than absorption) takes place without electron velocity restrictions provided that it is introduced into the field in certain special regions of space pervaded by the TE mode. This is a case where over-population of the upper state is accomplished through 'pumping' in real space. The relation between an electron cyclotron resonance maser based upon this principle and one based upon the principle of velocity space pumping, due to Twiss, is examined. This treatment provides physical interpretations and verifies the numerical results found earlier by Le Gardeur. Author (ESRO)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N69-19632# Brookhaven National Lab., Upton, N. Y.
NIOBIUM-TIN AND RELATED SUPERCONDUCTORS
R. B. Britton [1968] 3 p refs
(BNL-13021) Avail: CFSTI

Present knowledge of the superconducting compounds and their properties, and who is developing each type is reviewed. Experiences with several conductors and a technique for testing a complete conductor prior to using it in a device are reviewed also. To

show where the compounds fit into superconductivity, comparative data about a few of the compounds, alloys, and elements are tabulated. NSA

N69-19685# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France) Centre d'Etudes Nucléaires.
RHEOELECTRICAL APPROXIMATE SIMULATION OF MONOCRYSTAL GROWTH FROM THE MELT [SIMULATION RHEOELECTRIQUE APPROCHEE DU TIRAGE DE MONOCRISTAUX]
Goulven Vernois Jan. 1968 23 p ref In FRENCH; ENGLISH summary
(CEA-R-3657) Avail: CFSTI

The advantages of rheo-electrical simulation for studying monocrystal growth from the melt are discussed using a two-dimensional model. It is always possible to make a fairly exact model of an opaque body but the simulation of the radiation thermal exchange is fairly difficult for a transparent body. Plans for a constant level complex crucible are also described. Author (ESRO)

N69-19670*# Southern Methodist Univ., Dallas, Tex. Dept. of Physics.
BASIC RESEARCH IN SEMICONDUCTOR DETECTOR-DOSIMETER CHARACTERISTICS
George W. Crawford, ed. Aug. 1968 173 p
(Grant NGR-44-007-007)
(NASA-CR-100317; RR-68-1) Avail: CFSTI CSCL 20L

A detailed account of the theory and fabrication of lithium-drifted silicon detectors is presented, and theory and fabrication instructions are extended to apply to detectors of very large volume. The studies cover 70 different detectors ranging in size from 1×1×1 mm to 7×7×150 mm. Long detectors, i.e. detectors having proton path lengths of 10, 20, 30, 50, 70, 100, 120, 130, and 150 mm, were used for total absorption of high energy protons. The average energy required to produce an electron-hole pair in silicon was measured for each case. New techniques of fabrication, mounting, and encapsulation were developed to obtain specific configurations. Combinations of detectors were developed to permit simultaneous measurements of dE/dx and E, with identification of both mass and energy of the incident particle. The charge collection characteristics of the detectors in a magnetic field were determined, including detector service life properties. The results of the research permit fabrication of detector confiurations operating within a magnetic field which will produce the data required in the PROPER 3B Monte Carlo Transport Program to identify charge, mass, and energy of an unknown ionizing radiation of the meson, baryon, or heavier class. Detector charge responses were measured as a function of proton incident energy over the energy range from 8 to 186.6 MeV. K.W.

N69-19711# Commissariat à l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucléaires.
CONTRIBUTION TO THE MEASUREMENT OF THE REFLEXION COEFFICIENTS FOR CURVED CRYSTALS BETWEEN 50 keV AND 90 keV [CONTRIBUTION A LA MESURE DU COEFFICIENT DE REFLEXION DE CRISTAUX COURBES ENTRE 50 keV ET 90 keV]
Jean-Louis Chartier (Ph.D. Thesis—Paris Univ.) Sep. 1968 88 p refs In FRENCH; ENGLISH summary
(CEA-R-3555) Avail: CFSTI

The main approximate theories dealing with the diffraction of electromagnetic radiation by crystalline media and the determination of the characteristic properties of flat and bent crystals used in X and γ-Ray spectroscopy ('Laue Case') are described. A method and equipment to measure I', the reflectivity of elastically or plastically bent crystals, in far narrow wave-length intervals in the continuous X-Ray spectrum is also described. Experimental results obtained with different crystals (quartz (3140), Al (200), FLi (200) are compared with theoretical ones. Reference is also made to the use of the bent-crystal spectrometer (Cauchois arrangement) in dosimetry. Author (ESRO)

N69-19737 Pennsylvania State Univ., University Park.
PHASE EQUILIBRIA AND POINT DEFECT DESCRIPTION IN THE SYSTEMS La_2O_3–ThO_2, Gd_2O_3–ThO_2, Yb_2O_3–ThO_2, AND CaO–ZrO_2
Arthur Michael Diness (Ph.D. Thesis) 1967 241 p
Avail: Univ. Microfilms: HC $11.05/Microfilm $3.15 Order No. 68-11977

Subsolidus phase relations were investigated in three representative rare earth sesquioxide-thoria systems and the system CaO-ZrO_2. The investigation was conducted to carefully characterize phases of potential interest in solid state reaction kinetics studies. In addition, crystalline solubility characteristics related to the point defect character of these (fluorite-type) materials were determined. Dissert. Abstr.

N69-19781*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
IMPURITY PROFILE AND ENERGY BAND DIAGRAM FOR THE CUPROUS SULFIDE-CADMIUM SULFIDE HETEROJUNCTION
Henry W. Brandhorst, Jr. Washington Mar. 1969 18 p refs
(NASA-TN-D-5079) Avail: CFSTI CSCL 20L

Capacitance measurements were used to determine the impurity profile for a Cu_2S–CdS heterojunction formed by acid etching a polycrystalline, evaporated layer of CdS, and dipping it into a cuprous ion solution. Capacitance–voltage measurements were made both in the dark and under illumination. The barrier height of the junction was determined to be 0.85 V. The impurity profile is unaffected by red light, but blue light reduces the compensation of a copper-diffused CdS layer. The capacitance measurements, Hall measurements, and an electron microprobe analysis were used to assemble a band structure for the heterojunction which shows four distinct regions. Author

N69-19801 Pennsylvania State Univ., University Park.
DIELECTRIC PROPERTIES OF LEAD MAGNESIUM NIOBATE
James Wilmarth Smith (Ph.D. Thesis) 1967 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 68-8745

Single crystals of lead magnesium niobate were grown from a lead oxide flux. The weak field dielectric constant was measured from −30°C to +60°C with and without d.c. bias. The peak in the permittivity moved upwards in temperature with increased frequency and the magnitude of the real part of the permittivity decreased. The application of a d.c. bias caused a decrease in the permittivity. Sixty cycle hysteresis measurements were made from −150°C to room temperature and compared to similar loops measured by the Chynoweth pyroelectric method which gives the character of the static hysteresis. Comparison of the two sets of hysteresis loops demonstrated that much of the observed hysteresis is time dependent. The remanent polarization at low temperatures measured by the Chynoweth method was taken to be positive proof of the ferroelectric nature of lead magnesium niobate at low temperatures. Dissert. Abstr.

N69-19805*# Research Triangle Inst., Durham, N. C.
CORRELATION OF ELECTRICAL CONDUCTIVITY AND RADIATION-INDUCED FREE RADICAL CONCENTRATION IN POLY(ETHYLENE TEREPHTHALATE) AND RELATED COMPOUNDS
L. K. Monteith, D. T. Turner, and L. F. Ballard [1968] 67 p refs
(Contract NAS1-7553)
(NASA-CR-66743) Avail: CFSTI CSCL 20L

This report describes a research effort concerning the electronic processes in irradiated poly(ethylene terephthalate), PET, and two model compounds. The radical concentration in PET is shown to build up continuously as the γ-dose or UV light exposure is increased. Three different radicals are identified by ESR spectra. The relative concentration of each radical depends upon the degree of crystallinity of the sample. The optical absorption near 3100 Å and the electrical conductivity of irradiated samples are tied directly to the radical concentration. This is demonstrated by observing the rate of buildup of each effect and the kinetics of radical decay and conductivity decay at various temperatures. The quenching effect of oxygen is also shown to be similar for radical concentration, optical absorption, and electrical conductivity. Carrier mobilities are measured for PET and molecular crystals of dimethylterephthalate and dibenzoate ester of ethylene glycol. The mobility of the molecular crystals is observed to decrease significantly after exposure to γ-rays. Bulk and surface polarization effects are observed to play a dominant role in transient electronic behavior. Author

N69-19813# Sandia Corp., Albuquerque, N. Mex. Scientific Translation Service.
FAST LIBERATION OF ENERGY STORED USING SUPERCONDUCTORS [LIBERATION RAPIDE D'ENERGIE STOCKEE AU MOYEN DE SUPRACONDUCTEURS]
Gerard Prost et al 6 Dec. 1968 40 p refs Transl. into ENGLISH of French Rept. CEA-R-3255
(SC-T-68-1552) Avail: CFSTI

After a rapid description of the circumstances in which they first thought of using superconducting materials for the storage and liberation of energy, the authors examine, in comparison to condensers, the energy densities which can thus be stored, the methods used for introducing this energy into the superconducting circuit and for trapping it, and the law governing the discharge of this energy into a purely dissipative impedance. This leads to a derivation of the expression for the energy yield which depends on the characteristics of the switch used for opening the superconducting circuit. An experimental study was made of a superconducting switch with a view to understand the various parameters. As a result of the analysis, transitions of the switch, over the whole of its mass, were obtained for periods of a few microseconds, and energy yields close to unity were obtained. The obtention of fast discharges is now no longer a technological problem. Author (NSA)

N69-19841 Washington Univ., Seattle.
FINITE GEOMETRY EFFECTS IN SYSTEMS WITH CONDENSATION AND A STUDY OF A VARIATIONAL-CANONICAL TRANSFORMATION APPROACH FOR INTERACTING BOSONS
David Allen Krueger (Ph.D. Thesis) 1967 189 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-9303

In studying the effects of finite geometries and thermodynamic fluctuations on the existence of superconductivity and superfluidity, a symmetry breaking technique is used to show that the quasi-averages usually associated with superfluidity and superconductivity vanish in partially finite geometries; i.e., where at least one dimension extends to infinity. In the study of the variational principle and canonical approached far boson systems, it is shown that, if the canonical transformation conserves the number of particles, the only singular second order phase transition describable by this method must have a critical chemical potential which is independent of temperature. Thus the method is not applicable to liquid helium. Secondly, a Bogoliubov-type model was studied at arbitrary temperatures and densities and was found to exhibit an energy gap in the elementary excitation spectrum contrary to a general theorem. Dissert. Abstr.

N69-19877 California Univ., Los Angeles.
THE PHOTOCONDUCTIVE MODULATION OF MICROWAVES
Sidney Isaac Soclof (Ph.D. Thesis) 1968 227 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 68-12475

The photoconductive modulation of microwaves as a technique for semiconductor measurements is investigated. The propagation characteristics of an electro-magnetic wave in a medium is influenced by the density of free charge carriers. In the photoconductive modulation of microwaves the density of free charge carriers in a semiconductors is varied by means of the photogeneration process. The density of free charge carriers can then be used as an independent variable that can be controlled in an easy and continuous fashion by controlling the light intensity incident on the semiconductor. Various modulation effects can be produced by the photoconductive modulation of microwaves. The largest modulation effect is the change in the attenuation of a transmitted wave as the free carrier density in the semiconductor sample is varied. The presence of a d-c magnetic field will produce several magneto-microwave effects. The modulation of attenuation and the magneto-microwave effects using the free carrier density as an independent variable will be the subject of a major part of this study. Dissert. Abstr.

N69-19895 Utah Univ., Salt Lake City.
THE NONLINEAR MICROWAVE EFFECTS IN SUPERCONDUCTING FILMS
Su-Min Chou (Ph.D. Thesis) 1968 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-12442

The basic wave propagation problem in a rectangular wave guide with a thin conducting film placed across it has been solved. The microwave transmission and reflection are simple functions of film resistance and frequency. The experimental measurements and theoretical prediction gives reasonable agreement. As the thin film is in a superconducting state, the conductivity of the film is a function of the applied magnetic field. A Taylor's series expansion for conductivity σ involving the derivatives of σ with respect to the magnetic field H has been used to study the microwave nonlinear effects, especially for the harmonic generation. A rather complicated wave equation has been solved with the help of simplifying approximations to find the possible generated modes and power of harmonic signal. Dissert. Abstr.

N69-19909 Minnesota Univ., Minneapolis.
THE EFFECTS OF ALKALI OVERLAYERS ON LOW INDEX SURFACES OF GERMANIUM
Jar-Mo Chen (Ph.D. Thesis) 1968 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-12247

The effects of submonolayers of Na, K, and Cs are on the (111) and (100) surfaces of Ge were studied by low energy electron diffraction (LEED) techniques and by work function and electron reflectance measurements. It was found that every detailed

structure in the work function versus alkali coverage curves could be correlated with surface structure transformations, which in most cases were detected by LEED pattern observation and by electron reflectance spectra measurement. In some cases, the change escaped the observation by LEED, but was nevertheless detected by the reflectance technique. It is believed that the initial deposition of alkali on the (111) surface caused a complete relaxation of the Ge surface atoms to their bulk configuration. At higher coverages, it is proposed that the Na or K atoms started to form small closely bound groups leaving bare but relaxed areas of Ge surface in between. Dissert. Abstr.

N69-19912 Minnesota Univ., Minneapolis.
AC LOSSES IN THIN FILM HARD SUPERCONDUCTORS
Bruce Arnold Christensen (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-12248

Audio frequency alternating current losses in short sample hard superconducting niobium thin films were measured under transport current conditions by an electrical 4-probe method using a sensitive lock-in amplifier as a detector. The loss level for the films, which were vacuum deposited from 99.7% Nb rod, was in the range of about 1.5 $\mu\Omega$/cm to 5 $\mu\Omega$/cm at 10,000 Hz and 1 A. transport current. The films were 1 in. long and had various widths and thicknesses; the widths ranged from 0.05 in. to 0.1 in. wide and the thickness range was 500Å to 1300Å. The resistivity level of these films was about 5×10^{-12} Ω-cm at 10,000 Hz, compared to 10^{-8} Ω-cm for copper at liquid helium temperature. Dissert. Abstr.

N69-19957 Yale Univ., New Haven, Conn.
MOSSBAUER RESONANCE STUDIES OF IONS IN ICE
Arthur Jack Nozik (Ph.D. Thesis) 1967 216 p
Avail: Univ. Microfilms: HC $9.90/Microfilm $3.00 Order No. 68-13186

Mössbauer resonance studies have been carried out over a wide temperature range on frozen aqueous solutions containing ferrous, ferric, europic, and europous ions. Upon quenching from the liquid state of $-196°C$, aquo ions are trapped in the ice lattice and induced the formation of metastable cubic ice, rather than normal hexagonal ice. Warming of quenched samples to about $-80°C$ causes a non-reversible transformation to hexagonal ice and associated pronounced changes in the Mössbauer spectrum, including the disappearance of the resonance during part of the transition period. This latter phenomenon was used to obtain rudimentary information on the kinetics of the cubic-to-hexagonal ice phase transformation. Also, additional interesting phase changes in the ice-ferrous salt systems, involving solid state precipitation and eutectic formation, were monitored. Dissert. Abstr.

N69-19969 Ohio State Univ., Columbus.
THE MECHANICAL BEHAVIOR OF ELECTROCHEMICALLY POLARIZED NICKEL SINGLE CRYSTALS
Ronald Michael Latanision (Ph.D. Thesis) 1968 199 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-12851

Anodically and cathodically polarized nickel single crystals were deformed at room temperature in 1N H_2SO_4. The crystals were grown in an electron beam floating zone refiner, machined into tensile bars by means of a spark cutter, and annealed for 8 hours at 2100°F before deformation in uniaxial tension at a strain rate of 3.3×10^{-4} sec^{-1}. The stress-strain curves of cathodically polarized crystals were serrated, suggesting an interaction between hydrogen atoms and moving dislocations. The rate of work hardening in Stage I, θ_I, was increased in comparison to that of clean crystals deformed in the laboratory atmosphere. θ_{II} was less affected. Dissert. Abstr.

N69-19985* Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
SOLID-STATE MICROWAVE ELECTRONICS
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 19-22 refs (See N69-19981 09-34)
(Grant NGR-22-009-163)
Avail: CFSTI CSCL 20L

Theoretical and physical development work centered on low noise receivers, avalanche diodes, Schottk barrier diodes, and balanced mixer circuits. A number of intermediate frequency impedance measurements for an S-band mixer are reported. G.G.

N69-19989 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
MAGNETIC RESONANCE
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 51-52 (See N69-19981 09-34)
(Contract DA-28-043-AMC-02536(E))
Avail: CFSTI

An eight-pulse, four-phase cycle of RF field pulses has been successfully tested in experiments at 55 MHz carrier frequency on the ^{19}F resonance of a CaF_2 crystal. In this experiment and the freely precessing magnetization signal is sampled and held between pulses once during each cycle, and the resulting staircase smoothed by one stage of RC filtering, digitized, and stored in a signal averager. A typical transient of this kind, read out from the core on an X-Y plotter, appears in its Fourier transform, which corresponds to the unsaturated steady-state absorption spectrum of the ^{19}F spin system. Author

N69-20014 Florida Univ., Gainesville.
A TOPOLOGICAL APPROACH FOR STUDYING MICROSTRUCTURES
James Hider Steele, Jr. (Ph.D. Thesis) 1967 322 p
Avail: Univ. Microfilms: HC $14.65/Microfilm $1.15 Order No. 68-13033

The objective of this dissertation is to develop a topological approach for studying microstructure and microstructural phenomena in materials, and to apply it to the sintering process, the permeation of sinter bodies by non-wetting liquids, and grain structures in polycrystalline aggregates. The topological properties of the finite three-dimensional regions occupied by microstructural constituents are utilized to define their topological images. A relationship between the connectivity of these images and the genus of their separate bounding surfaces is demonstrated. This relationship allows the construction of network models having a connectivity equal to that of the constituent image. The basic Euler-Poincare equations for one- two- and three-dimensional manifolds with boundaries are described and used in this development. Dissert. Abstr.

N69-20021 Ohio State Univ., Columbus.
SOLUBILITY AND DIFFUSIVITY OF OXYGEN IN SOLID COPPER
Ronald Lee Pastorek (Ph.D. Thesis) 1968 188 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-12867

Three variations of a solid-state coulometric titration technique were used to determine the solubility and diffusivity of oxygen in solid copper in the temperature range 800°-1020°C. After an initial equilibration of the Cu crystal to a known oxygen activity, an identical d-c potential was impressed across both cells (Pt-Pt and Pt-Pt). The time-dependent flow of oxygen atoms into the copper from both sides was followed by a continuous measurement of the double cell current. From the solution of the diffusion equation and the time-dependence of the current, values for the solubility and diffusivity of oxygen in solid copper were derived. Dissert. Abstr.

N69-20022 Ohio State Univ., Columbus.
NUCLEATION AND EPITAXY OF SILVER ON SODIUM CHLORIDE
Joseph Lee Kenty (Ph.D. Thesis) 1968 178 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-12849

This dissertation considers the relationship between nucleation theory and epitaxy. It is shown that several experimentally observed features of epitaxy can be predicted from nucleation theory. The appearance of an epitaxial temperature, for example, can be predicted from classical nucleation theory using a simple model. Also, the predicted temperature and deposition flux conditions favoring epitaxial nucleation versus random nucleation are shown to be in qualitative accord with previous experimental observations. This dissertation further considers several aspects of nucleation theory. It is shown that the previously measured nucleation rate of silver on sodium chloride follows the formal equations of classical nucleation theory. Dissert. Abstr.

N69-20036 Ohio State Univ., Columbus.
THE IONIC AND ELECTRONIC DEFECT STRUCTURE OF PURE AND CHROMIUM-DOPED NICKEL OXIDE
Gerald Herbert Meier (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-12858

The electrical conductivity of pure nickel oxide (NiO) and nickel oxide doped with chromium (Cr) has been measured over a temperature range from 700 to 1200°C and an oxygen partial pressure range from the equilibrium pressure for Ni/NiO coexistence to 1.0 atmosphere. The solubility of Cr^{+3} in NiO has been determined from the break in the conductivity curve with increasing Cr content. This solubility was found to be 0.015 cation fraction Cr at 1100°C, 0.012 cation fraction Cr at 1000°C, and 0.009 cation fraction Cr at 850°C. The solubility was also found to be independent of P_{O_2} which further agrees with predictions made under the assumption that the Cr^{+3} ions are compensated in NiO by fully ionized cation vacancies. Dissert. Abstr.

N69-20165 Pennsylvania State Univ., University Park.
HARDENING MECHANISMS IN LITHIUM FLUORIDE, SODIUM FLUORIDE AND CALCIUM FLUORIDE BY SURFACE CONTAMINATION AND γ-IRRADIATION
Sanatkumar Ramanath Sashital (Ph.D. Thesis) 1967 157 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-8739

The effect of surface contamination by the ambient atmosphere on the ductility microhardness and dislocation mobility of LiF, NaF and CaF_2 single crystals has been studied. On exposure to atmospheric air, freshly cleaved surfaces of the above mentioned crystals undergo embrittlement, hardening and a reduction in the mobility of dislocations. The present investigations have established that these effects arise out of contamination of the surface layers by atmospheric oxygen. The observed changes in the above mentioned mechanical properties were also found to be dependent on the density and distribution of dislocation half loops on the cleaved surfaces prior to testing. It is believed that the oxygen molecules adsorbed on the surface get ionized into O^{2-} ions at the sites of emergence of edge dislocations and diffuse into surface layers by the "dislocation pipe diffusion" mechanism. Dissert. Abstr.

N69-20214# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF X-RAY AND ELECTRON RADIATION ON GaAs p-n JUNCTIONS
M. A. Krivov et al May 1968 8 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Fiz. (Tomsk, USSR), v. 10, no. 6, 1967 p 135–136
(AD-681256; FTD-HT-23-257-68) Avail: CFSTI CSCL 20/12

A study was made of the effect of x-ray and electron emission on the volt-ampere characteristics of gallium arsenide p-n junctions with the initial concentration of the current carriers of 4 x 10 to the 15th power/cc and a mobility of 3500 sq cm/V sec. The irradiation of the p-n junctions was accomplished using x-rays and electrons with energies of 90 KeV and 6.5 MeV respectivsly. On the basis of the results obtained, the following was established: (1) forward and reverse currents in p-n junctions are increased owing to the appearance of nonequilibrium current carriers during x-ray irradiation. Because of imperfections in gallium arsenide crystals, the rate of the recombination of current carriers was sufficiently high, and the observed changes of characteristics during irradiation were much smaller than changes during the irradiation of germanium and silicon diodes. The rectification factor of p-n junctions during irradiation varies by as much as 40% of the initial value; (2) the reverse current of p-n junction irradiated by electrons increase sharply in the prebreakdown voltage regions, and the breakdown voltage is decreased. This reverse branch of the characteristic can be explained by the development of radiation defects in the region of the p-n junction. Author (TAB)

N69-20272# Washington State Univ., Pullman. Shock Dynamics Lab.
EQUATIONS OF STATE IN SOLIDS Technical Summary Report, 9 Dec. 1966–8 Nov. 1967
G. E. Duvall, G. R. Fowles, M. H. Miles, and C. T. Tung Feb. 1969 144 p refs
(Contract DA-04-200-AMC-1702(X))
(AD-680960; WSW-SDL-68-01; TSR-2) Avail: CFSTI CSCL 20/11

An equation of state suitable for calculating the compression of a melting solid is described. Some elementary ideas about melting are reviewed and some standard relations between P and T in the melting region are described. The equation of state and melting law are combined in a program for calculating the Hugoniot through the mixed phase region. The Eyring theory for equation of state of liquids is examined for argon, and Hugoniot curves are calculated. The theory of plastic wave propagation in two-dimensions is discussed and calculations of allowed directions are described. Some of the basic physical mechanisms in solid-solid phase transitions are reviewed and the applicability of thermodynamics to such transitions is brought into question. An elementary model for a nonequilibrium transition in iron is suggested and p-v calculations are made for several values of the parameters. It is evident that no conclusions about the time dependence of the alpha-epsilon transition can be drawn from second state shock measurements, although it may be possible to infer useful information about metastable states. Author (TAB)

N69-20283 University of Southern Calif., Los Angeles.
A REINVESTIGATION OF THE CRYSTAL STRUCTURE OF SELENIUM, CHLORINE AND ADAMANTANE
Stewart Howard Goodman (Ph.D. Thesis) 1968 50 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 68-12035

With new powder data, the lattice constants and the structure of selenium were refined by least squares. During the refinement of the structure, a detailed study of the thermal motion was made. With the present powder data, the isotropic treatment of the thermal motion is as good as the anisotropic. The single crystal data for chlorine collected by Collin was refined by crystallographic least squares techniques. The investigation included a detailed study of

the thermal motion and of the effect of various weighting schemes. The powder pattern of Keeson and Taconis was reinterpreted to show that it actually represented the same orthorhombic cell found by Collin. The structure of the low temperature form of adamantane proposed by Nordman and Schmitkons is discussed.
Dissert. Abstr.

N69-20328# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Electrical Engineering.
SEMICONDUCTOR HETEROJUNCTION STRUCTURE STUDIES Final Report, 15 Dec. 1967–14 Sep. 1968
Donald L. Feucht and Arthur G. Milnes Sep. 1968 57 p refs
(Contract F19628-68-C-0179)
(AD-681173; AFCRL-68-0530) Avail: CFSTI CSCL 9/1

Single crystal ZnSe has been grown on Ge substrates by a close-spaced HCL transport process. Feasibility studies have been made of such semiconductor heterojunction structures and confirm that wide-gap emitter action is practical. Transistors of n-type ZnSe emitters on pGe-nGe base-collector structures have usuable current gains even though the emitter doping levels (10 to the 13th power donors/cu cm) are many orders of magnitude lower than the base doping levels (10 to the 19th power acceptors/cu cm). Effects on the current gain of parameters such as doping levels, base widths, current injection levels and temperature have been studied. Because of the low emitter doping levels, the emitter current flow is space-charge limited. Further study of this heterojunction pair is needed to determine its optical quantum efficiency, performance as a phototransistor and performance as a high frequency transistor.
Author (TAB)

N69-20340# City Coll. of the City of New York. Dept. of Physics.
PIEZO-ABSORPTION IN GERMANIUM
Erich Erlbach 19 Dec. 1968 5 p
(Grant AF-AFOSR-175-66)
(AD-680861; AFOSR-69-0050TR) Avail: CFSTI CSCL 20/12

The measurements of the piezo-absorption in the absorption edge region for germanium and silicon was concluded. A theoretical calculation of the matrix elements for these indirect transitions at the center of the Brillouin Zone in silicon was published in the Physical Review. The feasibility of using infrared absorption in the free carrier region of germanium to determine the relative electron population in the various valleys in n-germanium under uniaxial stress was demonstrated. The equipment for measuring the warm electron coefficient in germanium for arsenic doped n-Ge was assembled.
Author (TAB)

N69-20408# College of Aeronautics, Cranfield (England). Dept. of Electrical and Control Engineering.
SUPERCONDUCTIVITY: SOME ASPECTS OF THE THEORIES AND POSSIBLE APPLICATIONS
J. T. Hayden Oct. 1968 13 p refs
(CoA-Note-E/C-3) Avail: CFSTI

Superconductivity is an effect exhibited by certain materials at very low temperatures in which normal electrical resistivity disappears completely. Summaries of the current theories which attempt to account for this phenomena are presented, and various proposals for making use of this effect in practical devices are examined and discussed. Proposals for a program of research in the application of superconductivity to rotating electrical machines are outlined.
Author

N69-20414# California Univ., Berkeley. Electronics Research Lab.
ELECTROMAGNETIC WAVE-CHARGE INTERACTION IN CROSSED FIELDS Quarterly Progress Report, 16 May–15 Aug. 1968
K. A. Fox, S. Swierkowski, T. Duzer, and K. Weller Dec. 1968 34 p refs
(Contract DAAB07-67-C-0227)
(AD-680932; ECOM-0227-5; QPR-5) Avail: CFSTI CSCL 9/1

The purpose of the work is to investigate the interaction of electromagnetic waves and charge carriers in vacuum and solids. The construction of a crossed-field amplifier which will incorporate the results of our noise studies is in progress. Work on the crossed-field gun design method developed by R. A. Rao is being carried on to obtain designs for magnetically shielded guns. A method was developed for magnetically shielded guns. A method was developed for the application of a variational technique to reach an optimum compromise between desirable forms of variation of potential and beam thickness along the beam. An experimental and theoretical evaluation of the crossed-field acoustic-wave amplifier is being conducted. The comparison of optimum performance of ZnO longitudinal acoustic amplifiers with the InSb crossed-field counterparts has continued with an effort being made to get an improved basis for comparison in heat dissipation capabilities. The solution of the heat-flow problem is required before definite conclusions can be reached from the calculations.
Author (TAB)

N69-20431# National Bureau of Standards, Washington, D. C.
METHODS OF MEASUREMENT FOR SEMICONDUCTOR MATERIALS, PROCESS CONTROL, AND DEVICES
W. Murray Bullis Dec. 1968 51 p refs
(AD-681330; NBS-TN-472) Avail: SOD $0.50; CFSTI CSCL 20/12

The report describes NBS activities relating to: measurement of resistivity, carrier lifetime, inhomogeneities, and Hall effect in semiconductor crystals; study of infrared measurement methods, properties of deep-lying impurities (in InSb), and high field effects; establishment of a processing facility; evaluation of wire bonds; review of NASA measurement methods; and measurement of second breakdown in transistors, thermal properties of devices, and noise in microwave diodes. Projects on silicon nuclear radiation detectors and specification of germanium are also described. Supplementary data concerning staff, committee activities, technical and information services, and publications are included as appendixes. A list of ASTM Standards relevant to integrated circuit processing is also included.
Author (TAB)

N69-20438# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE RESEARCH Quarterly Technical Summary Report, 1 Aug.–31 Oct. 1968
Alan L. McWhorter 27 Dec. 1968 63 p refs
(Contract AF 19(628)-5167)
(AD-681141; ESD-TR-68-353) Avail: CFSTI CSCL 20/12

The report covers in detail the solid state research work at Lincoln Laboratory for the period 1 August through 31 October 1968. The topics covered are Solid State Device Research, Optical Techniques and Devices, Materials Research, and Physics of Solids.
Author (TAB)

N69-20449# Army Electronics Command, Fort Monmouth, N. J.
INTERACTION OF 10.6-MICRON LASER RADIATION WITH BULK SILICON
Jack Van Arsdale Oct. 1968 67 p refs
(AD-680895; ECOM-3023) Avail: CFSTI CSCL 20/12

The conduction process in semiconductors exhibits effects associated with inertia of the free carriers when the frequency of observation is of the order of the reciprocal of the relaxation time for the randomization of the momenta of the carriers. Since these effects can cause significant changes in the conductivity, permittivity, and attenuation constant in silicon, and since the principal parameter

determining these changes is the free carrier relaxation time t, it is necessary that an accurate value of t can be determined. When one examines different experimental data reported in the literature and deduces the value of t for silicon from these different sources, a basic discrepancy is found between the value of t for 10.6 micrometers and at microwave frequencies. The present paper derives the equations which account for the dependence of semiconductor parameters on free carrier (bipolar) relaxation time using a simple classical model. The experimental method for determining an accurate value of the bipolar relaxation time t for reasonably pure silicon is described. The experimental results give a value of t ~ 1.8 x 10 to the -14th power sec. This value is a factor of 1/12 smaller than that obtained from the experiments of others at microwave frequencies. One can conclude from the above (if the classical model used is valid at 10.6 micrometers) that t decreases with wavelength between 12,500 micrometers and 10.6 micrometers. Alternately, if one assumes that t is not a function of wavelength (which is the case for at least 12,500 micrometers and 10.6 micrometers) then it is evident from the anomaly in t that a classical model for free carrier absorption is inadequate. Author (TAB)

N69-20557# Missouri Univ., Rolla.
CALORIMETRIC MEASUREMENT OF NEGATIVE SURFACE ENERGY IN SUPERCONDUCTORS OF THE SECOND KIND Final Report, 1 Sep. 1965–31 Dec. 1968
Don C. Hopkins Dec. 1968 5 p refs
(Grants DA-ARO(D)-31-124-G650; DA-ARO(D)-31-124-G900)
(AD-680919; AROD-4970.2-P) Avail: CFSTI CSCL 20/13

The experimental details of this study are covered in the Ph.D. Thesis of Robert R. Riche entitled: A Calorimetric Study of the Effects of Surface Energy in a type II Superconductor. The entropy of the mixed state of type II superconductors has been investigated experimentally. The results have been interpreted in terms of the interaction of quantized fluxoids (near H sub c1) or solutions of the Ginsburg-Landau equations (near H sub c2) instead of the negative surface energy model of the original proposal. One of the experimental methods used was a direct calorimetric measurement of the head added to hold the sample at a constant temperature as the magnetic induction was increased. An accurate technique for determining the thermodynamic critical field for an irreversible sample was also a contribution of this work. Author (TAB)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N69-19784# Rocket Propulsion Establishment, Westcott (England).
SOLID PROPELLANT RHEOLOGY: A NEW EXPERIMENTAL TECHNIQUE
H. J. Buswell and J. F. Moloney Jul. 1968 25 p refs
(RPE-TR-68/6) Avail: CFSTI

A new experimental technique for studying the rheology of solid propellant, whereby gas pressures are used to stress a plug of propellant pressed into a rigid tube, is described. A reasonable approximation to storage and acceleration conditions in full scale charges is provided and the method can be used over a wide range of stress levels, temperatures and times. Deformations can be monitored and recorded during tests. Results for plastic propellant S 1044 are discussed and compared with results from centrifuge tests on similar specimens. Author (ESRO)

N69-20196*# Dynamic Science Corp., Monrovia, Calif.
A BASIC STUDY OF THE IGNITION OF HYPERGOLIC LIQUID PROPELLANTS Interim Report
L. B. Zung, E. A. Tkachenko, and B. P. Breen 15 Nov. 1968 59 p refs
(Contract NAS7-438)
(NASA-CR-100387; SN-80-MOD-3-F; IR-12) Avail: CFSTI CSCL 21I

A brief critical review of the ignition mechanism of the hypergolic propellant system hydrazine/nitrogen dioxide is presented. Quantitative analysis of the distribution of products due to gas phase reactions of hydrozine/nitrogen dioxide at low concentrations (≈ 1–6 mole %) and low temperatures (0°C and 25°C) give N_2O, NO, N_2, and H_2O as the main gaseous products. With an excess of hydrazine, hydrazinium nitrate is observed as the predominant solid intermediate. With excess nitrogen dioxide, ammonium nitrate is found to be the main solid intermediate. Any hydrazinium nitrate formed as an intermediate may be presumed to react with excess nitrogen dioxide to yield ammonium nitrate. Ignition studies are conducted using a burner based on the principle of stagnation flow field. By introducing nitrogen dioxide–nitrogen gas mixture to flow over liquid hydrazine, in a direction normal to the liquid surface, minimum concentrations of nitrogen dioxide that induce ignition are measured as a function of hydrazine temperature. For a 30% increase in flow velocity, it is observed that the threshold concentration of nitrogen dioxide increases by about 20%. Author

N69-20212*# United Technology Center, Sunnyvale, Calif.
AN EXPERIMENTAL STUDY OF SOLID PROPELLANT EXTINGUISHMENT BY RAPID DEPRESSURIZATION Final Technical Report, 3 Jan. 1963–3 Jan. 1969
G. E. Jensen Mar. 1969 109 p refs
(Contract NAS1-7815)
(NASA-CR-66747; UTC-2311-FR) Avail: CFSTI CSCL 21I

Systematic variations in propellant binder, oxidizer loading level, burning rate catalyst, metal loading, and exhaust pressure level were studied. The effects of motor configuration on extinguishment and reignition are discussed. Results indicate that combustion extinguishment requirements are determined by the binder type, percentage of ammonium perchlorate oxidizer, motor geometry, and exhaust pressure level as well as the pressure and depressurization rate. Author

N69-20263# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
THEORETICAL THERMODYNAMIC DATA AND CALCULATIONS OF PERFORMANCE OF THE ROCKET PROPELLANTS SYSTEM METHANE/NITROGEN TRIFLUORIDE FOR A CHAMBER PRESSURE OF 3.0 KP/CM SUP 2 [THEORETISCHE THERMODYNAMISCHE DATEN UND LEISTUNGSBERECHNUNGEN DER RAKETENTREIBSTOFF KOMBINATION METHANE/NITROGEN TRIFLUORIDE FUER EINEN BRENNKAMMERDRUCK VON 3.0 KP/CM SUP 2]
Winfried Buschulte and Helmut Koch 1 Dec. 1968 25 p refs In GERMAN; ENGLISH summary
(DLR-Mitt-68-25) Avail: CFSTI

For the rocket propellant system CH_4/NF_3 and a chamber pressure of 3.0 kp/cm^2 the main theoretical thermodynamic values, the characteristic rocket propulsion figures, and the vacuum specific impulse were computed and shown in diagrams and tables in dependence of the mixture ratio and the expansion ratio. Author

N69-20275# Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswich (West Germany).
THEORETICAL THERMODYNAMIC DATA AND CALCULATIONS OF PERFORMANCE OF THE ROCKET PROPELLANTS SYSTEM METHANE/NITROGEN TRIFLUORIDE FOR A CHAMBER PRESSURE OF 4.8 kp/cm SUP 2 [THEORETISCHE THERMODYNAMISCHE DATEN UND LEISTUNGSBERECHNUNGEN DER RAKETENTREIBSTOFF KOMBINATION METHANE/NITROGEN TRIFLUORIDE FUER EINEN BRENNKAMMERDRUCK VON 4,84 KP/CM SUP 2]
Winfried Buschulte and Helmut Koch Oct. 1968 29 p refs
In GERMAN; ENGLISH summary
(DRL-Mitt-68-26) Avail: CFSTI

For the rocket propellant system CH_4/NF_3 and a chamber pressure of 4.84 kp/cm^2 the main theoretical thermodynamic values, the characteristic rocket propulsion figures and the vacuum specific impulse were computed and shown in diagrams and tables in dependence of the mixture ratio and the expansion ratio. Author

N69-20285# Bureau of Mines, Pittsburgh, Pa.
CRASH FIRE HAZARD RATING SYSTEM FOR CONTROLLED FLAMMABILITY FUELS Final Report
Joseph M. Kuchta, Aldo L. Furno, George H. Martindill, and Agnes C. Imhof Mar. 1969 26 p refs
(FAA Order FA67NF-AP-24)
(FAA-NA-69-17; FAA-DS-68-25) Avail: Issuing Activity

A method for rating the potential crash fire hazard of gelled and emulsified hydrocarbon fuels was developed. The rating system is designed primarily for screening candidate thickened fuels with respect to their overall flammability hazard under laboratory-scale conditions. The fuel properties included in the rating system are minimum autoignition temperature, flash point, volatility rate, self spread rate, regression or burning rate, flame spread rate, and fire ball size under impact conditions; methods for determining these fuel properties are also described in the report. Experimental data on such fuel properties are presented for JP-4 and JP-5, or Jet A thickened fuels that were formulated with an emulsifying agent or with one of three different gelling agents submitted for evaluation. The results of these determinations and the numerical ratings derived for each fuel composition are discussed. Author

N69-20347# Catholic Univ. of America, Washington, D. C. School of Engineering and Architecture.
DEVELOPMENT OF EXPERIMENTAL STRESS ANALYSIS METHODS TO DETERMINE STRESSES AND STRAINS IN SOLID PROPELLANT GRAINS, CONSTANT ACCELERATION STRESSES IN A COMPOSITE BODY
V. J. Parks, A. J. Durelli, and Luis Farrer Oct. 1968 29 p refs
(Contract Nonr-2249(06))
(AD-681344; REPT-16) Avail: CFSTI CSCL 21/9.2

The report discusses the experimental stress analysis of composite structures subjected to gravitational forces. The immersion analogy is used to analyze stresses in composite bodies provided all the materials of such bodies have the same weight per unit volume. Applications are described in two-dimensional problems immersing urethane rubber models bonded to epoxy shells in a thallium formate solution. Photoelasticity is used to determine stresses. The method increases the response obtained, and will have application in the solution of problems where constant acceleration stresses are important as in dams and solid propellant rocket grains. Author (TAB)

N69-20504# Catholic Univ. of America, Washington, D. C. School of Engineering and Architecture.
DEVELOPMENT OF EXPERIMENTAL STRESS ANALYSIS METHODS TO DETERMINE STRESSES AND STRAINS IN SOLID PROPELLANT GRAINS. EXPERIMENTAL ANALYSIS OF HIGH FREQUENCY STRESS WAVES IN A RING Technical Report, Jan.–Nov. 1968
A. J. Durelli, J. A. Clark, and A. Kochev Nov. 1968 25 p refs
(Contract Nonr-2249(06))
(AD-681345; REPT-17) Avail: CFSTI CSCL 11/9

The paper deals with the photoelastic analysis of stress waves in a thick ring subjected to transient, high frequency loading; the device used to apply the loading is a piezo-electric transducer. Photoelastic data is supplemented by measurements obtained with a capacitance gage used as a dynamic lateral extensometer. A wave interpretation of the data is developed and comparisons are made with available solutions of related problems. Author (TAB)

N69-20559# Aerospace Corp., El Segundo, Calif. Lab. Operations.
TECHNIQUES FOR CONTROLLING EXOTHERMIC DECOMPOSITION OF AMMONIUM PERCHLORATE
Stanley W. Mayer, Leroy Schieler, and Elliot K. Weinberg Nov. 1968 33 p refs
(Contract F04701-68-C-0200)
(AD-680770; TR-0200(4210-10)-2; SAMSO-TR-68-278) Avail: CFSTI CSCL 7/4

In order to prevent or reduce premature reignition of extinguishable solid propellant motors, a laboratory investigation has been made to search for methods that could eliminate or reduce the exothermicity of propellant grade ammonium perchlorate exposed to temperatures of 350-390C. It was found that ammonium perchlorate (AP) in which this first exothermic peak was eliminated could be prepared by heating the propellant grade AP to 365-390C for several minutes and allowing it to cool. Furthermore, this exothermic peak was eliminated by the pre-heating technique even when fluorocarbon polymer binder was in contact with the AP. This technique for preventing the first exotherm was successful in all samples of AP tested; the samples were from several sources and in several particle sizes. It was found that the temperature at which the first exotherm occurred could be raised as much as 46C by adding several percent of an ammonium salt (e.g., ammonium fluoborate) to the AP. The delayed exotherm was stronger than that found in AP to which no ammonium salt was added. This technique also was effective when fluorocarbon binder was in contact with the AP. Neither technique appeared to reduce the heat liberated by the deflagration of AP at 470-500C. Co-crystallized ammonium salts were also tested as AP additives. Author (TAB)

N69-20646# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE NATURE OF IGNITION OF ATOMIZED FUELS FROM THE DIFFUSION AND KINETICS POINT OF VIEW
Yu. B. Sviridov May 1968 30 p refs Transl. into ENGLISH from Tr. Inst. Dvigateley Akad. Nauk SSSR (USSR), no. 9, 1960 p 98–112
(AD-680994; FTD-MT-24-84-68) Avail: CFSTI CSCL 21/12

Presence of concentration heterogeneity in a charge promotes acceleration of ignition. Basic determining process during ignition is the process of chemical transformation, but at high temperatures acceleration of the reaction due to a transfer of reacting particles from one zone to another is possible. Therefore, despite accepted views, it is necessary to recognize that the transfer process (even molar) can directly accelerate the chain-chemical transformation rate. This hypothesis explains the cause of displacement of ignition rate maxima for the flame propagation motor fuels to somewhat enriched mixtures due to the acceleration of initial and intermediate reactions to enriched mixtures. The presence of different mechanisms of ignition, determined by the relationship of intensities of reaction development and mixing, permits understanding the nature of different types of burning when the relationship changes. TAB

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N69-19666# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Mulheim an Der Ruhr (West Germany). Institut fuer Festigkeit.

EXPERIMENTAL INVESTIGATION OF SLOSH-SUPPRESSION EFFECTIVENESS OF ANNULAR-RING BAFFLES IN CONTAINERS OF SPHERICAL SHAPE [EXPERIMENTELLE UNTERSUCHUNG DER WIRKSAMKEIT VON RINGBLECHEN ZUR DAEMPFUNG DER FLUESSIGKEITSSCHWINGUNGEN IN KUGELFOERMIGEN BEHAELTERN]

K. Schiffner Oct. 1968 37 p refs In GERMAN; ENGLISH summary
(DVL-794; DLR-FB-68-64) Avail: CFSTI

A full-scale model tank made of polymethyl methacrylate and simulating the tank in the third stage of the ELDO-A launch vehicle was used in the tests. Test method and equipment are described. The measurements were performed for harmonic forced translational fluid oscillations of variable excitation amplitude, excitation frequency, and for variable width of the annular ring baffles. The results are summarized in a general empirical formula which can be used for calculating the damping value of spherical tanks with arbitrary width of annular-ring baffles. Author

N69-19707# Commisseriat à l'Energie Atomique, Saclay (France). Centre d'Etudes Nucléaires.

STUDY OF TRANSIENT STATES IN THERMIONIC CONVERTERS [ETUDE DES REGIMES TRANSITOIRES DES CONVERTISSEURS THERMOIONIQUES]

Jean-Pierre Landrot (Ph.D. Thesis--Paris Univ., 9 May 1967) 1968 136 p refs In FRENCH; ENGLISH summary
(CEA-R-3400) Avail: CFSTI

In order to control a thermo-ionic reactor, it is necessary to know the dynamic influence of four fundamental parameters: the injected thermal power, the electrical charge resistance, the temperature of the cesium and the thermal exchange coefficient of the collector cooling circuit. The principles of the thermo-ionic converter are briefly exposed. The over-riding influence of the first two parameters is shown with the help of experimental static readings. These two parameters are then made to vary in turn. The laws of variation as a function of the time, of the electrical power produced and of the temperature of the various parts of the converter are deduced. The laboratory model of the converter is studied theoretically and experimentally, and the nuclear converter has been the subject of an analog study. This work has made it possible to make a critical comparison of the various modes of obtaining the static characteristics, and to define the principles for controlling a nuclear thermo-ionic reactor. Author (ESRO)

N69-19731# Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon (France).

BLUE STREAK JET EXHAUST. CALCULATION OF MAXIMUM DIAMETER [ECLATEMENT DE JET BLUE STREAK. CALCUL DU DIAMETRE MAXIMUM]

J. C. Desbrieres 25 Mar. 1968 34 p refs In FRENCH
(Contract ELDO-CTR-17/3/15)
(LRBA-NT-E.1311-NT.7/EAS) Avail: CFSTI

The jet flow of the Blue Streak launch vehicle is calculated by the method of characteristics and by a global method which considers mixing with the external flow. The calculated dimensions of the jet are compared with optical observations of the F2 flight test. ESRO

N69-19739# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

PARAMETRIC INVESTIGATION OF AFTERBURNING AND NONAFTERBURNING AIRCRAFT IR SIGNATURES

E. Stokes Fishburne Mar. 1969 18 p refs Presented at 7th Symp. on Infrared Countermeasures, San Diego, Calif., 3-5 Dec. 1968
(RE-388J) Avail: Issuing Activity

A parametric investigation has been conducted to study various aspects of IR signatures of afterburning and nonafterburning jet aircraft. The analysis includes a simplified model for the engine hot parts and a rather involved technique for computing the radiation from hot gases. Our parametric investigation includes effects of the following parameters on the observed radiation: exhaust plume detail, atmospheric absorption (including two different approaches to this problem), absorption of radiation from engine hot parts by hot gases in exhaust plume, solid carbon particles, and assumed turbulent mixing model for the exhaust plume. Author

N69-19754*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

POWER MATCHING OF AN ION THRUSTER TO SOLAR CELL POWER OUTPUT

Eugene V. Pawlik 15 Jul. 1968 14 p refs
(Contract NAS7-100)
(NASA-CR-100275; JPL-TM-33-392) Avail: CFSTI CSCL 21C

A 20-cm diameter thruster was operated over a 2:1 range of output power, allowing for continuous matching of thruster power to a varying solar cell output level. The technique of matching power by varying either the ion beam current or the net accelerating voltage is described. Ion beam current control, implemented in thruster control loops, utilized existing laboratory hardware. Stable thruster operation was achieved over a range of 1000 to 2000 W. Bistable values of mercury propellant flow at the same discharge chamber and ion beam conditions were also observed. Author

N69-19782*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

EVALUATION OF 7.8-INCH-THROAT-DIAMETER INSERTS AND A UNIQUE COOLING CONCEPT IN A STORABLE-PROPELLANT ROCKET ENGINE

Jerry M. Winter and Donald A. Peterson Washington Mar. 1969 33 p refs
(NASA-TM-X-1756) Avail: CFSTI CSCL 20H

Nominal test conditions were 100 psia (689 kN/m^2) chamber pressure, an oxidant to fuel ratio of 2.0, and an initial throat diameter of 7.82 in. (19.8 cm). The propellants were nitrogen tetroxide and a blend of 50 percent hydrazine with 50 percent unsymmetrical dimethyl hydrazine. Magnesium oxide reinforced with metallic honeycomb failed structurally after 60 sec firing duration. AJT0992 (hafnium carbide, silicon carbide, graphite composite) provided nominal erosion protection for 140 sec. A unique active cooling concept was also evaluated. A perforated nozzle wall (linear) was used in conjunction with graphite ribs to conduct heat into an ammonium fluoroborate reservoir surrounding the liner. Three versions of the concept failed either structurally or by excessive throat erosion. These large-size inserts demonstrated less durability than the same materials in a smaller size. Author

N69-19804* Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.

SINGLE STAGE EXPERIMENTAL EVALUATION OF VARIABLE GEOMETRY GUIDE VANES AND STATOR BLADING. PART 5: OVERALL PERFORMANCE FOR VARIABLE CAMBER GUIDE VANE AND STATOR B WITH RADIAL AND CIRCUMFERENTIAL INLET FLOW DISTORTION

B. A. Jones, R. P. Oscarson, and C. E. Clark 31 Dec. 1968 93 p refs

(Contract NAS3-7804)

(NASA-CR-54558; PWA-ER-2640) Avail: CFSTI CSCL 21E

A single stage experimental investigation of a variable camber inlet guide vane, rotor, and variable geometry stator was conducted to determine the influence of radial and circumferential inlet flow distortion on the stage overall performance characteristics and stall margin. Tests were conducted with two settings of the variable camber guide vane, referred to as sea level takeoff (SLTO) and cruise configurations. Both configurations were tested at 70, 80, and 100% of the SLTO design equivalent rotor speed. The stage had a hub/tip ratio of approximately 0.5 and a tip diameter of approximately 43 inches, and in general resembled the front stage of a compressor for a high cruise flight Mach number engine. When operating at SLTO design rotor speed in the SLTO configuration, the radial and circumferential distortion resulted in 29 and 40% reductions in stall margin, respectively. Author

N69-19980*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PERFORMANCE OF VARIOUS OXIDE-MAGAZINE CATHODES IN KAUFMAN THRUSTERS

David C. Byers Washington Mar. 1969 29 p refs

(NASA-TN-D-5074) Avail: CFSTI CSCL 20H

The performance of various oxide magazine cathodes in the mercury discharge of a Kaufman thruster is presented. Emission current of the final design was 2.0 amperes at a cathode heater input power between about 70 and 80 watts during thruster operation. The emission current was found to follow a thermionic characteristic up to some level of emission, above which other limitations dominate the emission current. The emission current also appeared to be limited at high values of propellant utilization efficiency. Tests with a large variety of chemical constituents led to no fundamental improvements over the initial chemical block type. Author

N69-20193*# Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Operations.

LARGE HYDROGEN-OXYGEN ABLATIVE CHAMBER TEST PROGRAM Final Report

R. J. Kovach, J. A. Mellish, and R. W. Michel 14 Mar. 1969 222 p refs

(Contract NAS3-11214)

(NASA-CR-72512; AGC-9400-15) Avail: CFSTI CSCL 21H

A large-scale, silica phenolic, ablative-lined combustion chamber with a coaxial element injector having baffles, was tested to ascertain duration capability using the propellant combination of liquid hydrogen/liquid oxygen. The degradation of the liner was evaluated at nominal chamber pressures of 1040 psia and 570 psia at various over-all thrust chamber mixture ratios and a nominal hydrogen injection temperature of approximately 110°R. The average thrust regression rates of the liner wall in-line with the baffles were approximately 0.0023 in./sec (1040 psia chamber pressure) and 0.001 in./sec (570 psia chamber pressure) at a nominal over-all thrust chamber mixture ratio of 5.5. These average regression rates became approximately 0.004 in./sec (1040 psia chamber pressure) and 0.00275 in./sec (570 psia chamber pressure) between the baffles where the total fuel film coolant was less than in the in-line locations at the same 5.5 over-all thrust chamber mixture ratio. Author

N69-20194*# Martin Co., Denver, Colo.

CRYOGENIC METALLIC POSITIVE EXPULSION BELLOWS EVALUATION

D. T. Covington and R. F. Fearn Mar. 1969 38 p

(Contract NAS3-12017)

(NASA-CR-72513; MCR-69-67) Avail: CFSTI CSCL 21H

The expulsion efficiency test was performed on a test bench with the bellows assembly in the inverted position. The expulsion efficiency (ratio of the quantity of fluid expelled to that required to fill the device) was found to be 98.4% (the average of several tests). The liquid hydrogen cycle tests were preceded by a series of liquid nitrogen and hydrogen checkout tests to verify the integrity of the apparatus and the operating procedures. During the course of these checkouts it was observed that the bellows had failed (developed a leak in excess of 10^{-6} standard cubic centimeters of helium gas/sec). Consequently it was necessary to replace the original bellows with the spare bellows in order to accomplish the LH_2 cycle tests. The LH_2 cycle tests were performed in groups of 10 cycles each (20 reversals), followed by a leak check of the bellows while the system was cold. In addition, a "warm" leak check was ordinarily performed after each 20 cycles after the bellows assembly had been removed from the cryostat. Following the fifth group of cycles (100 reversals) a leak was detected (2×10^{-5} Scc He/sec) in the spare bellows in excess of the allowable value, thereby terminating the program as defined in the original contract. Author

N69-20242 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

AIR INLETS FOR MACH 7 FLIGHT [PRISES D'AIR POUR LE VOL A MACH 7]

J. Leynaert Nov. 1968 17 p refs In FRENCH

(E-267) Avail: CFSTI

The study is presented of a hypersonic ramjet the throat of whose combustion chamber remains fixed, and shows that the combustion should pass progressively from the subsonic to the supersonic regime during the accelerated phase of the flight. Depending upon the Mach number that has been selected as the start of supersonic combustion, the air intake configuration and the manner of adapting it to the flight Mach number are shown to be quite different. If for a cruising Mach of 7, combustion must start at Mach 4, the production of high mass flow at the lower velocities is facilitated by a weak internal contraction of the supersonic duct, and an air inlet may be defined which remains matched over a fairly large flight regime. If Mach 2 is selected to start the combustion, the possibilities of matching the air intake are more restricted, and may result in a configuration that is not well matched to the higher Mach numbers. A presentation is given of preliminary wind-tunnel tests of such a configuration. Author

N69-20388*# General Electric Co., Lynn, Mass. Aircraft Engine Technical Div.

EXPERIMENTAL EVALUATION OF OUTER CASE BLOWING OR BLEEDING OF SINGLE STAGE AXIAL FLOW COMPRESSOR. PART 4: PERFORMANCE OF BLEED INSERT CONFIGURATION NO. 3

C. C. Koch and L. H. Smith, Jr. 29 Aug. 1968 46 p refs

(Contract NAS3-7618)

(NASA-CR-54590; R68AEG357) Avail: CFSTI CSCL 21E

A 1120 feet per second tip speed rotor having an aspect ratio of 4.5 and an inlet hub-tip radius ratio of 0.5 was equipped with a porous outer casing so that air could be bled from over the blade tip for boundary layer control. Testing was conducted with distorted as well as undistorted inlet flow, and overall and stalling performance data were obtained for each inlet condition. It was determined that rotating stalls begin at the tip of the rotor with distorted inlet flow, and that in such a situation the extraction of boundary layer air is effective in increasing stall margin. With

undistorted inlet flow rotating stall begins at the pitchline for this rotor, and casing bleed does not produce significant improvements in stall margin. Author

N69-20637# Aeronautical Research Council (Gt. Brit.)
INVESTIGATIONS ON AN EXPERIMENTAL SINGLE-STAGE TURBINE OF CONSERVATIVE DESIGN. PART 1: A RATIONAL AERODYNAMIC DESIGN PROCEDURE. PART 2: TEST PERFORMANCE OF DESIGN CONFIGURATION
D. J. L. Smith, I. H. Johnston, and D. J. Fullbrook 1968 74 p refs Supersedes NGTE-R-283; ARC-28614; NGTE-R-292; ARC-29614
(ARC-R/M-3541; NGTE-R-283; ARC-28614; ARC-29614) Copyright. Avail: CFSTI; HMSO £1 11s 6d

The design of a turbine stage is described in which all leading parameters (stage loading, flow coefficient, pitch/chord ratio, blade profile shape and aspect ratio) have been selected conservatively to accord with current ideas for ensuring a reasonably high level of aerodynamic efficiency. From consideration of the influence of stage loading $K_{pT/Um2}$, flow coefficient V_a/U_m and rotor exit swirl angle 3, the stage design was selected such that these parameters were 1.15, 0.65 and 10 degrees respectively. At the design speed of $U_m/T_i = 34$ the resulting stage pressure ratio is approximately 1.65. Such a stage duty is "light" by aero engine standards but very comparable to much industrial gas turbine design practice. Blade spacing and profile shapes are finally selected in such a way as to preclude severe opposing pressure gradients on the suction surface which might result in local separation of the boundary layer from the blade surfaces. The methods applied and described for predicting blade surface velocities are simple and approximate only, and might readily be imitated by designers not wishing or able to exploit more elaborate and complex digital techniques. Author (ESRO)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N69-19606*# LTV Aerospace Corp., Dallas, Tex. Missiles and Space Div.
MAJOR SOLAR AND SOLAR INDUCED PHENOMENA DURING THE 20th SOLAR CYCLE. 1. THE FIRST SIX MONTHS OF 1967
Fred C. Jonah 14 Feb. 1968 58 p refs
(Contract NAS9-7134)
(NASA-CR-99564; Rept-00.1145) Avail: CFSTI CSCL 20H

Major solar or solar-induced events considered in this paper are: (1) four flares with importance ≥3B; (2) seven RF emissions at centimeter wavelength (1695, 2700, 2800, 3000, or 3750 Mc/s) with peak flux ≥500 flux units; and (3) five proton events observed by riometers, forward scatter, satellite, or ground-based neutron monitor. A statistical comparison is also made of the first six months of 1967 with the corresponding period of the 19th solar cycle, i.e. July–December 1956. K.W.

N69-19690*# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
AN EXPERIMENTAL STUDY OF ELECTRON FLUXES FROM 50 KEV TO 4 MEV IN THE INNER RADIATION BELT
Karl A. Pfitzer (Ph.D. Thesis) Aug. 1968 166 p refs Submitted for publication
(Contract NAS5-2071)
(NASA-CR-123) Avail: CFSTI CSCL 04A

A five channel magnetic electron spectrometer which is capable of accurately measuring the electron spectrum from 40 Kev to 4 Mev is described. The spectrometer consists of two separate detectors operating together to provide double energy selection. The first of these is an electromagnet with a collimating slit having a geometry factor of 8.64×10^{-3} sterad-cm^2. The second detector consists of a heavily shielded scintillation crystal and photomultiplier tube. The electron spectrometers were flown on the Orbiting Geophysical Observatories (OGO) I and III. The two spectrometers, which have been cross calibrated in space and shown to agree to within 10% observe the continuing decay of the electrons injected into the inner zone by the nuclear explosion, Starfish, on July 9, 1962. The spectrometers observe a factor of ten decrease in the electron flux over a period of two years from September 1964 to August 1966 in the inner zone below L = 1.8 for electrons of E > 290 Kev. Author

N69-19964# Institut Royal Météorologique de Belgique, Brussels.
STATISTICAL ANALYSIS OF ATMOSPHERIC TURBIDITY AT UCCLE DERIVED FROM RADIO OBSERVATIONS, 1951–1965 [ANALYSE STATISTIQUE DU TROUBLE ATMOSPHERIQUE A UCCLE A PARTIR D'OBSERVATIONS RADIOMETRIQUES, 1951–1965]
R. Dogniaux and P. Doyen 1968 42 p In FRENCH *Its* Publ. Ser. A, No. 65
Avail: CFSTI

During fifteen years (1951–1965), regular observations of the solar radiation classical components (direct, global and diffuse) have been carefully analyzed and preserved at Uccle (Belgium). By a statistical compilation of these records, the authors have established an analytical link between the Linke's turbidity factor T and the ratio D/G of the diffuse of the global radiation. The proposed relation: $D/G = (0.051 + 0.018m)T - 0.0016\delta - 0.0895$ makes allowance for the diurnal variation of the air mass m and the seasonal variation of the declination δ of the sun. A monthly tabulation of the mean and minimal hourly values of the turbidity factor is also given. The proposed analytical relations can be used for an easy computation of the three basic parameters which are peculiar to the energetic solar climate of a country. Author (ESRO)

N69-20046 California Univ., Berkeley.
OBSERVATIONS OF SOLAR FLARE ELECTRONS IN INTERPLANETARY SPACE
Robert Peichung Lin (Ph.D. Thesis) 1967 110 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-10360

The observations of > 40 keV solar flare electrons by the IMP-III and Explorer 33 satellites are used to study the emission of such electrons from the sun and their propagation in the interplanetary medium. It is found that there is very little diffusion transverse to the interplanetary magnetic field lines for these electrons in their propagation from the sun to the earth, and that the angular extent of the cone of propagation in interplanetary space filled with electrons reflects the angular size of the source at the sun. Comparisons of solar proton and electron onset times for mixed events indicate that the electrons are injected into the interplanetary medium earlier than the protons. The electron events are found to be accompanied by type III radio emission and impulsive centimeter and X-ray emission, all of which appear to be associated with the optical flash phase which occurs for many flares. Dissert. Abstr.

N69-20370# Maryland Univ., College Park. Dept. of Physics and Astronomy.
BOLIVIAN AIR SHOWER JOINT EXPERIMENT (CHACALTAYA COLLABORATION) Final Report, 1 Sep. 1966–31 Aug. 1968
Kamato Koichi, Yoshio Toyoda, Martin LaPointe, and Koichi Suga 28 Dec. 1968 60 p refs
(Grant AF-AFOSR-1176-66)
(AD-681194; AFOSR-69-0102TR) Avail: CFSTI CSCL 4/1

The Bolivian Air Shower Joint Experiment (BASJE) is a cooperative effort of Japanese, Bolivian and U. S. physicists to study the phenomena of cosmic ray air showers under half an atmosphere. The experiment is set up on Mt. Chacaltaya near La Paz, Bolivia at an altitude of 17,600 feet above sea level. The prime motivation for the experiment has been that air showers generated by primary gamma rays (as opposed to ordinary showers generated by protons or heavier nuclei) could be detected and identified by pecularities in the features of the showers observed. The air shower array was designed for this purpose and features a large (60 m2) shielded detector and an accurate means of determining the arrival direction of the showers. This report covers the period September 1, 1966--August 31, 1968. The document includes a status report on the gamma ray search. It also includes summaries of two other efforts which have been of recent interest to the collaborators of the experiment. TAB

N69-20606# Michigan Univ., Ann Arbor. Dept. of Astronomy.
BASIC SOLAR RESEARCH Annual Report, 1 Jan.–31 Dec. 1968
O. C. Mohler Dec. 1968 7 p refs
(Contract Nonr-1224(19); Proj. Vela)
(AD-681369) Avail: CFSTI CSCL 3/2

The report from the McMath-Hulbert Observatory contains a number of studies concerned with solar activity, solar flares, solar-terrestrial relationships, solar spectroscopy, and applications of hydromagnetic theory to the sun. Brief summaries of certain of these investigations are given. TAB

N69-20627# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
SOME OBSERVATIONS ON ENERGETIC ELECTRONS IN THE OUTER VAN ALLEN ZONE DURING AURORAL SUBSTORMS IN RELATION TO OPEN AND CLOSED FIELD LINES Progress Report
C. S. R. Rao Dec. 1968 17 p refs
(Contract Nonr-1509(06))
(AD-681007; Rept-68-66) Avail: CFSTI CSCL 4/1

Data regarding the high latitude boundaries and fluxes of electrons of energy greater than 40 keV in the midnight sector of the outer Van Allen zone during periods of auroral substorm activity are studied in this paper. It is observed that, during the expansive phase of a substorm, there is a large increase in flux but the boundary remains at the quiet time value (approx. 68 degrees). A simultaneous study of the latitudinal variation of the substorm activity indicates that its onset takes place at a latitude much lower than that of the outer zone boundary. From this it is concluded that the onset of auroral substorm activity takes place on closed magnetic field lines. Author (TAB)

N69-20634# Imperial Coll. of Sci. and Technology, London (England).
THE RADIAL AND AZIMUTHAL COMPONENTS OF COSMIC RAY STREAMING IN INTERPLANETARY SPACE
J. J. Quenby and A. Hashim Nov. 1968 36 p refs
Avail: CFSTI

The second harmonic of the cosmic ray daily variation may be explained by a symmetrical gradient rising away from the solar equatorial plane. Particles scattering across field lines into the equatorial plane under the influence of this gradient can give rise to a flow in the outward radial direction which will contribute to the diurnal wave. A model is calculated in which this flow is the sum of all contributions from the perpendicular gradient between the earth and the sun. The flow is proportional to $\epsilon = (K_\perp / K_{11})$, the ratio of the perpendicular and parallel diffusion coefficients at 1 A.U. and using magnetic field data it was estimated to be 6% of the solar wind velocity at 10 GV in 1964, a figure to be compared with the best direct experimental estimate of 2 ± 2 %. Using Parker's work on the reduction of the co-rotation component of cosmic ray streaming as a function of ϵ which shows that the azimuthal component is very small at $\epsilon \to 0$ and $\epsilon \to 1$, but rises to a peak in between, curves showing the variation of the radial and azimuthal components are produced as a function of ϵ. Examination of the phase and amplitude changes in the first harmonic of the daily variation from 1937 to 1966 shows that only part of the variation can be due to changes in the upper cutoff of modulation and a radial flow is required to explain the remaining variation at some epochs. The trend in the experimental results when radial and azimuthal flow components are assumed to exist with a constant upper cutoff rigidity is in fair agreement with the predicted curves. A similar trend is found in 1965-1967 when phase and amplitude is considered as a function of Ap. Author (ESRO)

N69-20658# Aerospace Corp., El Segundo, Calif. Lab. Operations.
TRAPPED ENERGETIC ALPHA PARTICLES IN THE OUTER RADIATION BELT
George A. Paulikas, J. Bernard Blake, and Stanley C. Freden Nov. 1968 32 p refs
(Contract F04701-68-C-0200)
(AD-681151; TR-0200(4260-20)-3; SAMSO-TR-68-471) Avail: CFSTI CSCL 4/1

Alphas with energies greater than 4.4 and 8.2 MeV were detected in the earth's outer radiation belt (near L = 3.0) with a counter telescope. These measurements were carried out in August 1966 aboard the near polar elliptical OV3-3 satellite (1966-70A). Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N69-19809*# Bellcomm, Inc., Washington, D. C.
LUNAR RESPONSE TO THE TIME-VARYING INTERPLANETARY MAGNETIC FIELD AND APPLICATION TO THE ALSEP MAGNETOMETER EXPERIMENT
W. R. Sill and J. L. Blank 8 Nov. 1968 32 p refs
(Contract NASw-417)
(NASA-CR-100320; TR-68-710-7) Avail: CFSTI CSCL 03B

A model is developed to predict the lunar response to the time varying interplanetary magnetic field. This model is applied to the interpretation of ALSEP magnetometer data. It is shown that, based on the theory, data from a single ALSEP magnetometer should be sufficient to calculate interior electrical conductivities. This appears adequate to discriminate between currently proposed hot and cold models for the lunar interior. Author

N69-19617*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYTICAL AND EXPERIMENTAL STUDY OF A SEPARATION SYSTEM FOR TWO SPINNING BODIES ON AN ATMOSPHERIC RE-ENTRY TRAJECTORY
Nathan D. Watson (M.S. Thesis—Va. Polytech. Inst.) Apr. 1968 73 p refs
(NASA-TM-X-61533) Avail: CFSTI CSCL 22C

An analytical and experimental solution for determining the longitudinal and transverse separation distances versus time between two hypervelocity spinning atmospheric reentry bodies is presented. The solution presented in this study is for a system consisting of a conical separation spring and two small solid fuel rocket motors. Analytical calculations are presented for the initial spring separation and the additional separation provided by the two small solid fuel rocket motors. A trailing wake model is presented based on a literature search, along with a discussion of its applicability to a hypervelocity blunted body. Input parameters for the rocket motor separation system analysis on a high-speed computer are discussed. Supporting test data of the rocket motor gaseous impingement forces in a vacuum are presented. Vector equations are derived for calculating the longitudinal and transverse separation distances of the two bodies. Resulting body motions and separation distances are presented for the reentry probe selected for this study. Author

N69-19638*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
GEOLOGICAL AND MINERALOGICAL ASPECTS OF THE NATURE OF TEKTITES [O GEOLOGO-MINERALOGICHESKIKH ASPEKTAKH PRIRODY TEKTITOV]
G. G. Vorob'yev Washington NASA Feb. 1969 17 p refs Transl. into ENGLISH from Meteoritika (Moscow), v. 28, 1968 p 73–84
(Contract NASw-1692)
(NASA-TT-E-12165) Avail: CFSTI CSCL 03B

The geological and mineralogical aspects of the nature of tektites are investigated and compared to those of terrestrial rocks. It is concluded that, according to the chemical compositions and physical properties investigated, tektites have no affinity with terrestrial rocks, particularly sedimentary ones. It is shown that the lunar impact hypothesis concerning the origin of tektites has no apparent contradictions at the present level of knowledge in this field. Author

N69-19640*# National Aeronautics and Space Administration, Washington, D. C.
APPLICATION OF THE GRADIENT METHOD TO THE NUMERICAL STUDY OF LIMITED POWER TRANSFERS BETWEEN NEAR-COPLANAR CIRCULAR ORBITS. COMPARISON WITH LINEARIZED SOLUTION [APPLICATION DE LA METHODE DU GRADIENT A L'ETUDE NUMERIQUE DES TRANSFERTS A PUISSANCE LIMITEE ENTRE ORBITES CIRCULAIRES COPLANAIRES PROCHES. COMPARAISON AVEC LA SOLUTION LINEARISEE]
Herve Girard Aug. 1968 49 p refs Transl. into ENGLISH of the FRENCH REPT. ONERA-NT-12
(NASA-TT-F-11879; ONERA-NT-12) Avail: CFSTI CSCL 22C

By means of a numerical method, the optimum trajectories for orbital transfers between coplanar circular orbits having nearly the same radius and for power-limited propulsion systems whose ejection velocity may vary, are found. The results obtained are compared to those given by a linearized analytical calculation. The gradient method which has been used following an examination of the various applicable methods of optimization, allowed various radius ratios close to unity, in order to obtain the transfer trajectories with and without rendezvous as well as the corresponding consumption. An examination of these results leads to an evaluation of the validity of the hypothesis of linearization around the initial orbit as a function of the radius ratio. Author

N69-19651* Boeing Co., Seattle, Wash.
LUNAR ORBITER IMPROVED PHOTO SUPPORT DATA LUNAR ORBITER 1 Final Report
W. G. Moyers [1969] 670 p refs Supersedes D2-100751-7
(Contract NAS1-7954)
(NASA-CR-66735-1; D2-100815-1; D2-100751-7) Avail: CFSTI CSCL 22A

This document is one of five volumes comprising the photo data from Lunar Orbiter missions. This volume contains a description of and tabulates the photo supporting data for all the Lunar Orbiter 1 photos, based on postmission analysis of orbit trajectory and spacecraft performance factors. The two categories of data are: (1) the supporting data information; and (2) supporting and evaluation data. The supporting data information define the parameters contained in the photo evaluation computer program (EVAL); the version of the ephemeris data used; and the sources of input data required for computation of the photographic supporting data. The supporting and evaluation data include output listings of the EVAL computer program for each photo. Author

N69-19652* Boeing Co., Seattle, Wash.
LUNAR ORBITER IMPROVED PHOTO SUPPORT DATA LUNAR ORBITER 2 Final Report
W. G. Moyers [1969] 1340 p refs Supersedes D2-100752-7; See N68-12216
(Contract NAS1-7954)
(NASA-CR-66735-2; D2-100815-2; D2-100752-7) Avail: CFSTI CSCL 22A

Lunar Orbiter 2 data in this volume are of the same type as those described in abstract N69-19651.

N69-19653*# Boeing Co., Seattle, Wash.
LUNAR ORBITER IMPROVED PHOTO SUPPORT DATA LUNAR ORBITER 3 Final Report
W. G. Moyers [1969] 1344 p refs Supersedes D2-100753-7
(Contract NAS1-7954)
(NASA-CR-66735-3; D2-100815-3; D2-100753-7) Avail: CFSTI CSCL 22A

Lunar Orbiter 3 data in this volume are of the same type as those described in abstract N69-19651.

N69-19654* Boeing Co., Seattle, Wash.
LUNAR ORBITER IMPROVED PHOTO SUPPORT DATA LUNAR ORBITER 4 Final Report
W. G. Moyers [1969] 1184 p refs Supersedes D2-100754-7; See N67-40434
(Contract NAS1-7954)
(NASA-CR-66735-4; D2-100815-4; D2-100754-7) Avail: CFSTI CSCL 22A

Lunar Orbiter 4 data in this volume are of the same type as those described in abstract N69-19651.

N69-19655* Boeing Co., Seattle, Wash.
LUNAR ORBITER IMPROVED PHOTO SUPPORT DATA LUNAR ORBITER 5 Final Report
W. G. Moyers [1969] 1371 p refs Supersedes D2-100755-7; See N68-13760
(Contract NAS1-7954)
(NASA-CR-66735-5; D2-100815-5; D2-100755-7) Avail: CFSTI CSCL 22A

Lunar Orbiter 5 data in this volume are of the same type as those described in abstract N69-19651.

N69-19788*# Nuclide Corp., State College, Pa.
THE ANALYSIS OF THE LUNAR ATMOSPHERE BY A MASS SPECTROSCOPE
L. F. Herzog and S. R. Gryczuk. Sep. 1968 52 p refs
(Contract NASw-1480)
(NASA-CR-100318) Avail: CFSTI CSCL 03B

A major portion of the effort during the present contract was spent in the design, fabrication, testing and evaluation of a TOF system that would meet weight, power, size and other "guidelines" for lunar experiments. The performance tests made indicate that the present instrument is capable of performing lunar atmospheric analysis of all constituents of mass 1-100 possessing partial pressure above about 10^{-13} torr in a scan of only a few minutes duration, at a resolution of 100 or more. As it was intended that this program be continued, this "final" report is actually a progress report on this prototype TOF spectrometer, which, in our view, is now suitable for hardening into a lunar-environment-qualified model adequate for its proposed mission; nevertheless, many avenues of potential improvement opened in this study remain to be followed up in the future. Author

N69-19838*# TRW Systems, Redondo Beach, Calif.
STUDY OF PIONEER MISSIONS TO JUPITER, VOLUME 1 Final Report, 3 Jun.–25 Oct. 1968
25 Oct. 1968 595 p
(Contract NAS2-4900)
(NASA-CR-73278; TRW-11339-6003-R0-00-Vol-1) Avail: CFSTI CSCL 22A

A conceptual design study is presented on requirements and performance of an Atlas Centaur launched spacecraft to make interplanetary, asteroid belt, and Jupiter environment measurements in the early 1970's. The scientific requirements of the mission are discussed, and payload components and constraints on the spacecraft are identified. Other inherent mission constraints on the spacecraft are set forth, including performance characteristics of the designated launch vehicle and characteristics of Earth–Jupiter trajectories. The selected spacecraft and its subsystems are described, and the rationale for the selection from alternative designs detailed. The design of an equivalent Jupiter Pioneer spacecraft which employs radioisotope thermoelectric generator (RTG) power instead of solar power is presented. The applicability of both solar- and RTG-powered spacecraft for advanced missions and the additional performance requirements for these growth missions are indicated. K.R.G.

N69-19890*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IRON LINE EMISSION FROM X-RAY SOURCES
S. S. Holt, E. A. Boldt, and P. J. Serlemitsos. Aug. 1968 10 p refs
(NASA-TM-X-63475; X-611-68-343) Avail: CFSTI CSCL 03B

X-ray sources for which thermal models have been proposed should exhibit line structure for energies below 10 keV. The $(1s)^2\,{}^1_0\,1s\,2p$ transition in Fe XXV at 6.64 keV is that emission line which is characteristically the most easily observable, and its presence (or absence) in experimentally observed spectra is shown to severely constrain proposed models. Author

N69-19923*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ANALYSIS OF SATELLITE POSITIONAL UNCERTAINTY BY STATISTICAL MECHANICS
N. L. Bonavito. Dec. 1968 13 p refs
(NASA-TM-X-63457; X-552-68-465) Avail: CFSTI CSCL 22C

The justification for the acknowledgment of satellite positional uncertainty through in-track error buildup is considered for a statistical mechanics viewpoint. The equations of motion of the Hamilton–Jacobi theory specify a region or volume in phase space in which the system point moves. Since the system is in statistical equilibrium, initially it will have a specified energy, and the theorem of the integral invariants of Poincaré guarantees that volume in phase space in which the system point moves with an initially specified energy, will be constant in time, even though forces influencing the system will cause a distortion or elongation of the volume with time. Therefore, in traversing this distorted volume, an error factor in the equations of transformation will necessitate a change in the constant of the motion which relates to the time of perigee passage, and hence the mean anomaly. Since the secular part of the mean anomaly is by far the largest portion, then any error accumulated here can be brought out in terms of an in-track projection, and will be mainly secular in nature. Author

N69-19973*# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhoven (West Germany). Institut fuer Flugmechanik.
THE CAPTURE AND ESCAPE BEHAVIOUR OF PLANET/MOON-SYSTEMS [DAS EINFANG- UND KATAPULTVERMOEGEN VON PLANET/MOND-SYSTEMEN]
O. Bachorr and A. Leibold. Dec. 1968 48 p refs In GERMAN; ENGLISH summary Presented at Symp. on DGRR Interplanet. Raumflugmissionen, Munich, 7 Dec. 1967
(DVL-795; DLR-FB-68-81) Avail: CFSTI

Flyby behavior for planet/moon systems is investigated. The velocity gains and the conditions for capture and escape are calculated. The maximum capture velocity of a Jupiter/Ganymede flyby is 4.5 km/sec. It is hypothesized that the irregular moons of Jupiter, Saturn, and Neptune were captured by a flyby process. Author

N69-19982 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
MOLECULAR BEAMS
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 1–6 (See N69-19981 09-34)
(Contract DA-28-043-AMC-02536(E); Grant MIT-99)
Avail: CFSTI

It is assumed that created matter consists of atomic hydrogen in its ground state and that the rate of charged particle creation is proportional to the number of nucleons (or nuclei) present. Also developed is a theory of ionic impurity at metal surfaces where the net charge configuration can be expressed by a multipole expansion. The dipole moments are calculated as functions of impurity surface separation, conduction band electron density, impurity parameters, and crystal work functions. G.G.

N69-19984* Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
RADIO ASTRONOMY
In its Electron. Lab. Res. Activities 15 Jul. 1968 p 9–18 refs (See N69-19981 09-34)
(Contract NSR-22-009-120; Grant NsG-419)
Avail: CFSTI CSCL 03B

Reported astronomical observations cover the search for interstellar oxygen[18] hydrogen molecules in the galactic center, the development of a long baseline stellar interferometer, and a degenerate parametric amplifier for a K band multiple channel radiometer. A possible microwave experiment for a planetary Venus probe is outlined. G.G.

N69-20023*# Bellcomm, Inc., Washington, D. C.
VARIANCE OF LUNAR SLOPES
A. H. Marcus. 27 Nov. 1968 14 p refs
(Contract NASw-417)
(NASA-CR-100278; TR-68-340-7) Avail: CFSTI CSCL 03B

The root-mean-square (rms) slope over a finite span on a cratered planetary surface is derived theoretically. The rms slopes from Ranger 7 observations of Mare Cognitum are in very good agreement with predictions. Author

N69-20026*# IIT Research., Chicago, Ill. Astro Sciences Center.
LONG RANGE PLANNING STUDIES FOR SOLAR SYSTEM EXPLORATION Final Report, 1 Mar. 1963–1 Dec. 1968
Jan. 1969 113 p refs
(Contract NASr-65(06))
(NASA-CR-100364; A-6) Avail: CFSTI CSCL 22A

This report is a final summary of all the work done for advanced lunar and planetary missions. Developed was a uniform background of knowledge of the solar system, an understanding of the mission requirements for exploring the solar system, and an objective, systematic analysis capability for both scientific and technological objectives. The general areas of work which have been pursued to meet the broad objectives of planning support required may be summarized as: (1) cost estimation methods; (2) objectives of advanced mission; (3) analysis of mission requirements; (4) general trajectory studies; and (5) spacecraft technology studies in support of mission analysis. Author

N69-20027*# IIT Research Inst., Chicago, Ill. Astro Sciences Center.
THE MULTIPLE OUTER PLANET MISSION (GRAND TOUR)
David L. Roberts, comp. Jan. 1969 290 p refs
(Contract NASr-65(06))
(NASA-CR-100363; M-16) Avail: CFSTI CSCL 22A

The Multiple Outer Planet Mission (Grand Tour) was studied for major problem areas in order to further verify the mission concept and to provide a background for later Phase A study. The specific aims of the study were: (1) to determine the guidance requirements to perform the mission; (2) to identify the scientific commonality between the planets Jupiter, Saturn, Uranus, Neptune; (4) to define "minimum" and "representative" scientific payloads; and (4) to estimate the launch vehicle requirements to perform the mission. Author

N69-20028* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA RAY ASTRONOMY BALLOON RESULTS
C. E. Fichtel, D. A. Kniffen, and H. B. Ogelman Feb. 1969 41 p refs
(NASA-TMX-63482; X-611-69-58) Avail: CFSTI CSCL 03A

Results are given for high altitude balloon flights of the Goddard gamma ray digitized spark chamber telescope. The data on the galactic center region is reanalyzed in terms of a possible line source in the galactic plane. The flux and energy spectrum of the atmospheric background were measured as a function of angle with respect to the vertical. The measured downward flux is in reasonable agreement with measurements of other experimenters at several energies; however, the upward flux for energies above 100 MeV is a factor of about three lower than that measured in the OSO-3 experiment. This difference seems larger than would be expected, but small compared to the difference between the galactic gamma-ray flux observed by OSO-3 and the predicted one. The upper limits to possible point sources of gamma rays are summarized and shown generally to fall below the fluxes expected from a straight extrapolation of the X-ray spectra. No positive evidence for a point source has been found. Author

N69-20071 Royal Observatory, Edinburgh (Scotland).
OBSERVATIONS OF INTERSTELLAR REDDING. 5: RESULTS FOR REGION IN MONOCEROS
K. Nandy 1968 12 p refs Publ. of its Vol. 6, No. 7
Avail: HMSO 5s 6d

The extinction law in the direction of Monoceros has been determined from spectrophotometric measurements in the wavelength range 8000A to 3450A, and is compared with results previously obtained for regions in Cygnus, Cepheus, Cassiopeia and Perseus. Author

N69-20072 Royal Observatory, Edinburgh (Scotland).
RESULTS OF A SEARCH FOR GLOBULES IN OB CLUSTERS AND ASSOCIATIONS
M. E. Sim 1968 30 p refs Publ. of its Vol. 6, No. 8
Avail: HMSO 9s 6d

A search for Bok globules has been made in OB clusters and associations which have previously been searched for dust-embedded stars. A catalogue has been produced by the globules found by inspection of the Palomar Observatory Sky Survey prints of 48 clusters and associations north of 33° declination. The catalogue includes the X, Y coordinates, referred to the POSS prints, angular sizes, shapes, and orientations of the globules. The globules have been divided into three groups, containing certain, probable, and doubtful globules, respectively. Author

N69-20108 Purdue Univ., Lafayette, Ind.
THE PERTURBATION EFFECTS OF A MAGNETIC DIPOLE ON A CHARGED SATELLITE
Ernest Doyle Vogt (Ph.D. Thesis) 1968 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-12634

The motion of a point mass-charge about a homogeneous sphere having a magnetic dipole at its center is investigated. A parameter ϵ measuring the strength of the magnetic force relative to that of the gravitational force is introduced, and the assumption $\epsilon << 1$ is made. The motion of the particle is then determined by developing the osculating Keplerian elements as functions of the true anomaly in asymptotic expansions in ϵ. For motion at zero inclination, the orbital equation and the modified Kepler equation are also obtained in asymptotic expansions in ϵ. Dissert. Abstr.

N69-20123 Royal Greenwich Observatory, Herstmonceux (England).
INVESTIGATION OF PROPER MOTIONS IN THE FIELD OF THE CLUSTER M67. 2: THE OUTER REGION
C. A. Murray and E. D. Clements 1968 35 p refs Prepared jointly with Royal Obs., Cape Town, So. Africa
(BULL-139) Avail: HMSO 5s 6d

An account is given of the measurement of proper motions down to B $\approx 16^{m}.5$, in an area of approximately $1^{\circ} \times 1^{\circ}$ centered 18' to the west of the nucleus of M 67. Photometry on the R,G,U system for most of the stars measured has been provided from unpublished material and is included in this paper. The color-magnitude diagram of the cluster members in the outer region closely resembles that for the central region. The outer region contains suspected red giants which are redder and brighter than those in the central region, but very few subgiants and no blue 'upper main-sequence' stars; the gap in the main sequence is very pronounced. The surface distribution of cluster members selected according to proper motion is compared with the work of Artyukhina and Kholopov from star counts. The brighter stars appear to be more concentrated toward the center compared with the fainter ones. There is little evidence for departure from circular symmetry over the area examined. The cluster radius, defined by the faint stars, is about 38 Author

N69-20124 Royal Greenwich Observatory, Herstmonceux (England).

INVESTIGATION OF PROPER MOTIONS IN THE FIELD OF THE CLUSTER M67. 3: THE FIELD STARS, AND THE MOTION OF THE CLUSTER

C. A. Murray 1968 29 p refs Prepared jointly with Royal Obs., Cape Town, So. Africa

(BULL-141) Avail: HMSO 4s 6d

Proper motions of all field stars brighter than $m_G = 15^m$, and a few fainter red stars, in one square degree near M 67 are discussed. The likely luminosity and population characteristics of stars in small regions of the color-magnitude diagram are derived from their proper motions and dispersions. It appears that there is a significant increase in the velocity dispersion with height above the galactic plane. It is suggested that the majority of the brighter red stars are distant halo giants, and that some other stars at intermediate colors also belong to the halo. A kinematic frame of reference based on main-sequence stars and the halo giants is set up, to which all the proper motions including that of the cluster may be referred, and it is shown that this system is consistent with the fundamental system, derived from the motion of Praesepe, to within 0.003 per annum. Information is obtained on the space distribution and luminosity function of stars whose proper motions indicate that they are dwarfs. The absolute and peculiar motions of the cluster, relative to the sun, are derived. Author

N69-20143 Royal Observatory, Edinburgh (Scotland).

THE DISTRIBUTION OF OB STARS IN THE NORTHERN MILKY WAY

M. E. Sim 1968 72 p refs *Its* Publ. Vol. 6, No. 5

Copyright. Avail: HMSO: £2

From data available in the Hamburg–Warner and Swasey catalogue of "Luminous Stars in the Northern Milky Way", charts were produced of the galactic distribution of OB+, OB and OB− stars in the range $0° < l^{II} < 225°$, $-10° < b^{II} < +10°$. The galactic coordinates of all stars in volumes I and II of the catalogue were computed, and histograms of the longitude distribution of OB stars were drawn.

N69-20187# Weapons Research Establishment, Salisbury (Australia).

A SIX DEGREES OF FREEDOM TRAJECTORY PROGRAM FOR RIGID MULTI-STAGE ROCKET PROPELLED VEHICLES INCLUDING A SPECIAL ABRIDGEMENT TO COMPUTE BOMBLET TRAJECTORIES

J. S. Hunter Nov. 1968 71 p refs

(WRE-TN-HSA-135) Avail: CFSTI

This note describes a program, designated I.G.2.22.1, written to compute trajectories of a missile having up to three stages. The vehicle is considered to be a rigid body with any number of fins and possessing six degrees of freedom in space. The program includes the effects of certain launcher constraints, pulse rockets, jet damping, thrust misalignment, aerodynamic and mass asymmetries, and the rotation of the earth. Provision is made for the inclusion of Magnus Moments in addition to yaw induced forces and moments tabulated as functions of Mach number, roll orientation and incidence. The program is written in FORTRAN II and an IBM 7090 computer. A listing of the program is presented. In addition, a shortened version of the program, particularly suited to the simulation of bomblet trajectories, is outlined, and variations of this abriged version from the main program are noted. Author

N69-20301 Michigan Univ., Ann Arbor.

THE USE OF CONSTRAINTS TO IMPROVE NUMERICAL INTEGRATION OF TRAJECTORIES ON DIGITAL COMPUTERS

John Lewis Kurzenberger (Ph.D. Thesis) 1968 186 p

Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-13345

A method, which is similar in complexity to the simple integration of the standard translational equations of motion, is developed for computing orbits under the influence of small perturbing forces. Such a method is applicable to the use of small to moderate size digital computers with relatively simple integration routines. The resulting equations are free from many of the singularities encountered in the standard variation of orbital elements technique, so that they can be used to consider the full range of orbital trajectories. Dissert. Abstr.

N69-20382 RAND Corp., Santa Monica, Calif.

GRAVITY ASSIST FROM JUPITER'S MOONS FOR JUPITER-ORBITING SPACE MISSIONS

R. W. Longman Dec. 1968 48 p refs

(Contract F44620-67-C-0045)

(AD-680757; RM-5479-PR) Avail: CFSTI CSCL 22/3

The report describes results of an investigation of the propellant economies of using the gravitational attraction of Jupiters four large moons to effect the transfer of a spacecraft into orbit around that planet. Use of a simplified model to approximate the maximum possible energy change as a function of the approach energy shows that the maximum energy loss from a flyby of Ganymede, the largest moon, is less than half that required to transfer from a high-thrust approach trajectory to an acceptable elliptical orbit. Thus, chemical retro-thrust is necessary to effect the transfer, and a moon swingby may not be justified. With a low-thrust trajectory approach, however, economical gravity assist from a moon is more promising. The lower approach energies of optimal low-thrust trajectories can be further reduced by retrothrusting, and guidance problems are more easily handled. A no-impulse capture could result in a final orbit with a one-year orbital period. Moreover, the relaxation of the required velocity endpoint conditions for low-thrust trajectories may allow significantly increased payloads or shorter flight times. Author (TAB)

N69-20397# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.

A PARTICULATE THERMOPHYSICAL MODEL OF THE LUNAR SOIL

D. F. Winter and J. M. Saari Dec. 1968 55 p refs Submitted for publication

(D1-82-0725) Avail: Issuing Activity

Calculations based on several thermophysical models of the lunar soil are compared with recent observations at far infrared wavelengths; none of the models reproduces simultaneously the lunation nighttime and eclipse cooling measurements. A new particulate thermophysical model of the lunar soil is described which utilizes results from the Surveyor spacecraft and from laboratory experiments with evacuated powders. The new model gives good agreement with both lunation and eclipse data in the far infrared and is consistent with measurements of lunar brightness temperatures at millimeter wavelengths. Particulate models are also used to determine the diurnal variation of the infrared surface brightness temperature of the hot pole of Mercury. Author

N69-20618# Boeing Scientific Research Labs., Seattle, Wash.

FAMILIES OF PERIODIC ORBITS CONTINUED IN REGULARIZING COORDINATES. THE HECUBA GAP AND THE HILDA GROUP

Andre Deprit and Julian Palmore Sep. 1968 40 p refs *Its* Mathematical Note No. 573

(AD-680810; D1-82-0764) Avail: CFSTI CSCL 3/3

The first paper contained in this note documents the numerical

method which is the tool used extensively to extract the physical conclusions very concisely reported in the second paper. A predictor-corrector algorithm is proposed for continuing analytically families of periodic orbits beyond collision trajectories in the restricted problem of three bodies. It is based on Hills equation for normal variations in Thieles regularizing coordinates. The direct planetary orbits of the first kind and the Hilda family both bifurcate out of the family of retrograde planetary orbits of the first kind by triplication of the same orbit. The branching occurs in the Hecuba gap. The period curve of the Hilda family shows a peak indicative of invariant tori of quasi-periodic motions inside which could be trapped the Hilda group of asteroids. Author (TAB)

N69-20648# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISTRIBUTION OF METEORIC BODIES BY ENERGIES (EXPERIMENT IN WHICH λ = 9.59m)

E. I. Fyalko et al Mar. 1968 11 p refs Transl. into ENGLISH from Inform. Byul. Geofiz. i Astron., Akad. Nauk Ukr. SSR (Kiev), no. 9, 1966 p 165–169

(AD-680995; FTD-HT-23-1207-67) Avail: CFSTI CSCL 3/1

In accordance with the results of radar observations of meteors in which lambda = 9.6 m during the time of the meteoric shower of the Geminids in 1963, a graph was made of the distribution of the meteoric bodies in accordance with their kinetic energies. With the extreme character of the velocity distribution (differential) of the meteoric bodies and the monotonically decreasing mass distribution of the meteoric bodies, and kinetic energy distribution of these bodies also is of a diminishing nature. The results of the experiment are in agreement with the analytical conclusions regarding the character of the law of energy distribution of meteoric bodies. Author (TAB)

N69-20656*# Boeing Co., Seattle, Wash.

APPLICATION OF RESIDUAL FEEDBACK TO LUNAR ORBITER RESIDUAL ANALYSIS Final Report

P. E. Hong and P. B. Liebelt [1968] 34 p refs

(Contract NAS1-7954)

(NASA-CR-66738; D2-100818-1) Avail: CFSTI CSCL 22C

Orbit determination in the presence of mathematical model errors produce statistics which are highly unrealistic. This has been definitely shown in the lunar orbiter data for the orbital phase in which the standard deviations on the spacecraft state vector are much too optimistic or smaller than is physically possible. A technique is described which uses feedback from the measurement residual space to the state estimate space in order to force the covariance matrix of state to be compatible with the actual measurement residuals. Author

N69-20677*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OUTLINE OF RELATIVISTIC COSMOLOGY FOR COSMIC GAMMA-RAY STUDIES

F. W. Stecker Mar. 1969 14 p

(NASA-TM-X-63486; X-641-69-89) Avail: CFSTI CSCL 03B

In the general theory of relativity, Einstein set out to identify the gravitational field with the geometry of space-time itself. He derived an equation using differential geometry which identified the curvature of space-time with the matter-energy density contained in it. The Einstein field equations were written in tensor form and take on four values, one time-like and three space-like. Gamma-ray fluxes emitted at large redshifts were calculated considering the effect of cosmological factors, and the metagalactic gamma-ray spectra from various high-energy interactions were evaluated. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N69-19611*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ANALYSIS OF THE STATIC AND DYNAMIC CHARACTERISTICS OF A DECOUPLED LANDING ENTRY VEHICLE

James Ernest Haile (M.S. Thesis—Va. Polytech. Inst.) May 1968 49 p refs

(NASA-TM-X-61526) Avail: CFSTI CSCL 22B

A theoretical analysis of the static and dynamic characteristics of an entry vehicle utilizing the decoupled landing concept has been conducted. A hypersonic arbitrary-body aerodynamic computer program was used to determine the aerodynamics of the basic body. Three theories were used and compared with data obtained for a Mach number equal to nineteen. Several stabilizing devices were investigated to determine which were the most effective in providing static stability. To evaluate the lateral-directional handling qualities, parameters were derived to be applicable during hypersonic entry. Equations were also derived for determining the contribution of the stabilizing devices to the dynamic stability derivatives. In the evaluation of the vehicle dynamic characteristics linearized equations of motion for the longitudinal and lateral-directional modes were used at several points along a maximum performance trajectory. The parameters considered throughout the trajectory were the period and the time to damp to one-half amplitude. Author

N69-19650*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EXPLORATORY EXPERIMENTAL AND ANALYTICAL STUDY OF SEPARATING TWO PARALLEL LIFTING STAGES OF A REUSABLE LAUNCH VEHICLE AT MACH NUMBERS OF 3 AND 6

John P. Decker (M.S.Thesis—Va. Univ.) May 1968 104 p refs

(NASA-TM-X-61471) Avail: CFSTI CSCL 22D

Static longitudinal aerodynamic data were obtained for both stages of a representative two-stage rocket-powered reusable launch vehicle concept when the stages were in close proximity to each other. The effects of vertical spacing, longitudinal spacing, and incidence angle were determined at Mach numbers of 3 and 6. Using the wind-tunnel data together with estimates of the dynamic derivatives obtained for similar type vehicles and also the vehicle and initial trajectory input data, the implication of the interferences on the individual vehicle dynamics was obtained at Mach numbers of 3 and 6 by numerically integrating the equations of motion for both vehicle stages. Author

N69-19697*# Bellcomm, Inc., Washington, D. C.

ON SPACE VEHICLE ATTITUDE STABILIZATION BY PASSIVE CONTROL MOMENT GYROS

J. W. Schindelin 8 Nov. 1968 42 p refs

(Contract NASw-417)

(NASA-CR-100280; TM-68-1022-9) Avail: CFSTI CSCL 22B

In this paper the basic equations of motion for space vehicles with various passive CMG configurations are presented. As the exact equations of motion are nonlinear, linear models or linearized expressions have been established. This is of major importance especially for system design as the linearized equations allow one to determine explicitly the influence of system parameters on

performance. It was found that for step and sinusoidal input functions, the errors due to linearization are less than 1%. Special attention was given to friction phenomena, i.e., viscous and Coulomb friction, which arise in connection with the motion of the CMGs about their respective gimbal axes. It was found that friction decisively influences system performance. Coulomb friction, in general, severely restricts the attitude stabilization capability of the CMGs until the space vehicle has attained a certain angular velocity. Author

N69-19899*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
APPLICATIONS TECHNOLOGY SATELLITE Quarterly Progress Report, 1 Sep.–30 Nov. 1968
Nov. 1968 48 p refs
(Contract NAS5-3823)
(NASA-CR-100329; SSD-80523R; QPR-18) Avail: CFSTI CSCL 22B

Details of the Applications Technology Satellite (ATS) spacecraft program are presented. The basic spacecraft parameters and payloads are tabulated. The ATS development and launch program provides for the fabrication of basic spacecraft and system test equipment, using the techniques and subsystems developed under the Advance Technological Development Program. Appropriate combinations of equipment are integrated with the basic spacecraft to complete the flight vehicles. The planned program includes vehicle and subsystem developmental design varification testing and flight acceptance testing of each flight vehicle. In addition, launch center operations and mission operations in support of the vehicle launches and initial orbital operations are included. Author

N69-19758# European Space Vehicle Launcher Development Organization, Paris (France).
GENERAL TRENDS IN POSSIBLE CONFIGURATIONS OF THE ELDO LAUNCHERS
P. Blanc Nov. 1968 20 p
(ELDO-Publ-13) Avail: CFSTI:

The EUROPA-I and EUROPA-II launchers under development should give ELDO the possibility of injecting into orbit a geostationary satellite of about 200 kg. The next generation of launchers should increase this capability to 500-700 kg, while at the same time opening the way for a third generation capable of carrying payloads three or four times bigger. The techniques envisaged for achieving this, assuming Blue Streak or an equivalent as first stage, are the following: liquid propellant boosters consisting either of Blue Streaks or of equivalent stages derived to a greater or lesser extent from the techniques used for the first stage of the DIAMANT B launcher; (1) a second stage 3 m. in diameter (Preferably, but not necessarily hydrogen-propelled); (2) an upper stage with advanced propulsion, chemical, electrostatic (solar or nuclear power source) or nuclear-thermal (power source a small fast reactor). Although the use of hydrogen was envisaged in the first instance (ELDO-B type launcher), it would seem to be an advantage to start off the second generation with liquid boosters added to the EUROPA-I launcher, the other techniques being held in reserve for the future though without discontinuing their study. This would secure the required performance while making maximum use of the experience gained and the existing hardware, and while preparing the way for subsequent, more powerful launchers. Author (ESRO)

N69-19868*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRUCTURAL ANALYSIS OF THE INJUN 5 SPACECRAFT STRUCTURE
Thomas C. Jones (M.S. Thesis—Va. Polytech. Inst.) Jun. 1968 75 p refs
(NASA-TM-X-61531) Avail: CFSTI CSCL 22B

The forces and deflections on the idealized structure of the Injun 5 spacecraft structure subjected to accelerations were determined through methods utilizing finite element techniques. These techniques were based on energy methods and were compiled for use in an existing structural computer program. Experimental tests were conducted to show that the structure was capable of surviving in the test acceleration environment and to obtain strains for comparison with the analytical. Author

N69-19945*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
MARS SPINNING SUPPORT MODULE STUDY. VOLUME 1: SUMMARY
31 Jan. 1969 259 p
(Contract NAS1-8638)
(NASA-CR-66732-1) Avail: CFSTI CSCL 22B

The gross characteristics of the Flyby-Video Data and Orbiter MSSM designs which received the major study effort are illustrated. The Flyby-Entry Data design, which also received considerable attention, is similar to the Video Data design, the primary difference being the incorporation of a much smaller square planar antenna. Since most of the SM design problems were associated with the structural, flight control, and telecommunications subsystems, the major study efforts were devoted to these subsystems. The Flyby-Video and Entry Data SM designs weigh 558 and 521 pounds, respectively, including the propellent. The Orbiter design weighs 1120 pounds, including the reaction control and orbital insertion system propellant. These weights added to the A/L adapter, and canister weights result in total weights which are within the Titan III-C payload capabilities. The net weight margins are 105, 138, and 90 pounds, respectively, interpreted as available for SM, adapter, and canister contingencies. Author

N69-19946*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
MARS SPINNING SUPPORT MODULE STUDY. VOLUME 2: ANALYSIS
31 Jan. 1969 265 p
(Contract NAS1-8638)
(NASA-CR-66732-2) Avail: CFSTI CSCL 22B

The order of presentation of the study material in this volume is based on the significance attached to the SM design concepts with respect to the Mars 1973 program rather than chronological order of the study. The Flyby–Video Data design is presented first, giving detailed trajectory/navigation, structural, attitude and velocity control, reaction control, telecommunication, power, and mission sequence of events background data. Next, the same aspects of the Flyby–Entry Data design are presented, but mainly in terms of differences between it and the Video Data design. The Orbiter design is then presented with advantage taken of its commonality to the Flyby designs and emphasis placed on its unique features. A discussion of the alternate designs considered during the initial period of study is also included. Author

N69-19979# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Institut fuer Angewandte Geodynamik.
AERODYNAMIC COEFFICIENTS OF THE REUSABLE BALLISTIC ROCKET NEPTUN [AERODYNAMISCHE BEIWERTE DER WIEDERVERWENDBAREN TRAEGERRAKETE NEPTUN]
H. Riedel Dec. 1968 47 p refs In GERMAN; ENGLISH summary
(DVL-308; DLR-FB-68-75) Avail: CFSTI

The aerodynamic coefficients of models of the complete system and of the first reentry stage of the ballistic space transportation

system "Neptun" have been measured for Mach numbers M = 2.25 to 4.15 in the 30 × 30 cm^2 supersonic wind tunnel of the DVL. Apart from force measurements, pressure distribution measurements have been carried out on the model of the reentry stage 1. Author

N69-20012 Virginia Polytechnic Inst., Blacksburg.
FREE VIBRATION OF A ROTATING BEAM-CONNECTED SPACE STATION
James LaMar Milner (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 68-12657

The free vibration of a rotating beam-connected space station is analyzed with a mathematical model of the space station which represents the general three-dimensional motion of the various components of the system. The space station is composed of two space modules connected by a flexible beam, and the system is caused to spin in the plane of its orbit in order to produce an artificial gravity environment within the space modules. The kinetic energy and potential energy of the space station are used to develop a Lagrangian function of the system. Hamilton's principle is used to determine a set of governing equations, and a set of boundary conditions representing a clamped-clamped attachment of the beam to each space module is applied to the ends of the beam. Within the limits of small deflection theory the motion of the space station is shown to be uncoupled into two separate types of motion. Dissert. Abstr.

N69-20126 California Univ., Los Angeles.
ANALYTICAL INVESTIGATION OF THE ATTITUDE STABILITY OF SPACE VEHICLES
Pierre-Yves Henri Willems (Ph.D. Thesis) 1968 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-12476

This dissertation deals with theoretical considerations on systems of nonlinear ordinary differential equations with small nonlinear terms and time-varying coefficients. The solutions of slightly nonlinear equations with periodic coefficients are approximated by the use of the asymptotic expansion method. A complete treatment of systems with several degrees of freedom is presented. Systems governed by coupled Mathieu's and Hill's type second order equations are considered. Complete information on the stability of the system under consideration is obtained and the limits of regions of parametric resonances are given in analytical form in approximate form. A general formulation for the dynamics of deformable bodies, based on the concept of normal modes of deformation and the influence of an inverse-square field are investigated. The attitude stability of rigid symmetrical and unsymmetrical satellites on circular and elliptical orbits are investigated. General stability criteria are presented, and a simple example of a two-body system is developed. Dissert. Abstr.

N69-20211* Boeing Co., Seattle, Wash.
LUNAR ORBITER SIMPLE MOON RESIDUALS
T. J. Hansen [1968] 663 p
(Contract NAS1-7954)
(NASA-CR-66738; D2-100818-1) Avail: CFSTI CSCL 22A

The improved Lunar Orbiter state vector solutions, when projected ahead using a simplified lunar gravitational model, show characteristic residual (calculated minus observed) doppler patterns. These patterns are presented as plots of residuals vs. time for all data arcs processed in the photo site accuracy analysis contract. Author

N69-20281*# Boeing Co., Seattle, Wash.
LUNAR ORBITER DOPPLER RESIDUAL STUDY Final Report
Gayle D. Barrow [1968] 91 p refs
(Contract NAS1-7954)
(NASA-CR-66737; D2-100817-1) Avail: CFSTI CSCL 22A

The input data for improved photo location calculations are presented under the analysis categories (attitude maneuvers, exposure times, lunar radii, camera field of view, and state vectors). They were used to produce the replacements to the Postmission Photo Supporting Data documents for each Lunar Orbiter flight. Author

N69-20346# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOCIALISM: THE PATHFINDER INTO SPACE
G. V. Petrovich May 1968 12 p Transl. into ENGLISH from Pravda (Moscow), 1967 p 3
(AD-681311; FTD-HT-23-1595-67) Avail: CFSTI CSCL 22/1

A description is given of the powerful booster rockets and spacecraft built in the USSR, and a list of all the Soviet space firsts follows: artificial satellite launched; space rocket fired; photographs of the opposite side of the Moon; space rocket launched in direction of Venus, etc. Author (TAB)

N69-20423# Royal Aircraft Establishment, Farnborough (England).
A DESCRIPTION OF THE ARIEL 3 SATELLITE
H. J. H. Sketch Jul. 1968 22 p Presented at the Royal Soc. Meeting on Sci. Results Obtained by Ariel 3 Satellite, London, 24 Apr. 1968
(RAE-TR-68189) Avail: CFSTI

A brief account is given of the shape and systems of Ariel 3, followed by a discussion of the heat balance, data storage and compatibility problems. These topics were selected to show the close relationship between the scientific and technological aspects of the work. Author (ESRO)

N69-20633# TRW Systems, Redondo Beach, Calif.
OCTAHEDRAL RESEARCH SATELLITE MARK 3: OV5-1 (ERS 27) Final Report, 15 Dec. 1965–28 Apr. 1967
Mac C. Chapman, James B. Gradner, and Randall J. Martin Apr. 1968 67 p
(Contract AF 19(628)-5817)
(AD-680827; AFCRL-68-0265) Avail: CFSTI CSCL 22/2

The Octahedral Research Satellite - Mark III, ERS 27 (Air Force designation OV5-1) was launched into an eccentric earth orbit on 28 April 1967, and assigned international designation 1967-40E. The satellite was instrumented with a scientific payload and support subsystems designed to monitor soft X-rays, bremsstrahlung, and protons from solar active regions. The spacecraft was a regular octahedron with 11.5 inch edge length, weighing 16.3 pounds. It was designed to be spin stabilized at a rate of 12 RPM, and produce an average sunlit power of 4.0 watts. The scientific payload consisted of eleven radiation detectors and a sun aspect sensor. The payload data was sampled by a twenty-three segment commutator, processed by an IRIG 5 subcarrier oscillator, and transmitted in real time to the ground stations via a PAM/FM/PM 136MHz transmitter operating at 1 watt. Author (TAB)

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N69-19612# Los Alamos Scientific Lab., N. Mex.
SPALLATION CRITERIA FOR NUMERICAL COMPUTATIONS
Rodney S. Thurston and William L. Mudd 13 Nov. 1968 12 p refs
(Contract W-7405-ENG-36)
(LA-4013) Avail: CFSTI

Spallation is the fracture of a material in dynamic tension. Previously published spallation criteria were dependent on stress rate, stress gradient, and cumulative damage models. A modified stress gradient, and cumulative damage models. A modified stress gradient criterion was favored for its ease of application to both hydrodynamic and characteristic calculations and for the availability of suitable data. The criterion states that the tensile stress at which spallation occurs is a function of the static tensile strength, and the tensile stress gradient. A method is presented for estimating spallation criteria from static tensile strength data for metals. The method is useful for estimating spallation criteria when experimental data are unavailable and when temperatures are other than those at which the data were collected. The stress gradient spallation criterion is compared with results from experiments which produced zone yielding in copper and spall planes in a copper–aluminum–copper sandwich. Author (NSA)

N69-19678 Delaware Univ., Newark.
THREE-DIMENSIONAL STABILITY ANALYSIS FOR SLENDER, INITIALLY STRAIGHT, AND CURVED RODS UNDERGOING LARGE DEFLECTIONS
Wilhelmus Johan Schaffers (Ph.D. Thesis) 1967 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-13166

Systems of equations are developed which describe the occurrence of three-dimensional buckling of a rod initially straight or curved that has undergone large planar deflections caused by terminal couples and forces only. The equations are solved by means of a large digital computing machine using a very accurate Runge–Kutta type integrating method, with an automatic step size control. Several classes of symmetric planar configurations are investigated with various sets of boundary conditions. It has been found that the onset of three-dimensional buckling depends strongly on the boundary conditions (fully clamped ends versus planarly clamped ends) and on the material response, expressed as the ratio of torsional to bending rigidity. The existence of two different types of buckling mode for initially curved rods was found experimentally and confirmed by analysis. Dissert. Abstr.

N69-19703# Laboratoire de Recherches Balistiques et Aérodynamiques, Vernon (France).
STUDY AND REALIZATION OF LAUNCH VEHICLE SCALE MODELS FOR VIBRATION TESTS [ETUDE ET REALISATION DE MODELES REDUITS DE LANCEURS SPATIAUX DESTINES A DES ESSAIS DE VIBRATIONS]
M. Vallee 4 Nov. 1968 19 p refs In FRENCH
(LRBA-NT-72/68/SEN) Avail: CFSTI

After a brief introduction on the advantage of using launch vehicle scale models for vibrational tests, the problems and the difficulties involved in the study and realization of such models are described. Some examples of scale models made in the U.S. are also illustrated. ESRO

N69-19726# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DISCRETE-ELEMENT PLASTIC ANALYSIS OF STRUCTURES IN A STATE OF MODIFIED PLANE STRAIN
G. Isakson Aug. 1968 36 p refs
(RM-421) Avail: Issuing Activity

Matrix relations are developed which govern the stresses and strains in a discrete-element idealization of prismatic solid in a state of modified plane strain. Such a state is characterized by uniform, but not necessarily zero, normal strain in the longitudinal direction. When this strain is not zero, the mean stress in cross sections must be specified. The matrix relations take advantage of the pseudo-two-dimensional nature of the problem. A solution procedure is outlined based on an incremental application of the loading and linearization of the plastic stress-strain relations within each loading step. Appropriate plasticity relations for both isotropic and kinematic hardening theory are presented. The latter permits the treatment of cyclic and reversed loading into the plastic range. An important area for application of the developed procedure is that of transverse and combined transverse and longitudinal loading of unidirectional filamentary composites. Author

N69-19794*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INFLUENCE OF LARGE DEFORMATIONS AND MIDPLANE FORCES ON THE PLASTIC BEHAVIOR OF IMPULSIVELY LOADED PLATES
Edwin T. Kruszewski (Ph.D. Thesis—V. Polytech. Inst.) Apr. 1968 143 p refs
(NASA-TM-X-61521) Avail: CFSTI CSCL 20K

This analysis of impulsively loaded plastic plates includes effects of large deformations and midplane forces. Specifically, it deals with a circular plate of uniform thickness simply supported at its edges. The impulsive loading is characterized by an initial velocity distribution. Equilibrium equations are derived for the motion of the plate which are consistent with the von Karman plate theory. Governing equations are then developed for the three possible phases of motion. These governing equations are solved for two types of bending-moment–midplane-force interaction relationships. One relationship is based on displacement of the neutral surface from the midplane surface. The second is based on the magnitude of the midplane forces. Both types of plastic plate behavior are examined. Plots of final central deformation for various applied midplane forces and impulses are presented that clearly illustrate that even small amounts of midplane forces have a significant effect on the final deformation of plastic plates. A comparison between results of the large deformational analysis and experimental data shows excellent agreement. Author

N69-19875 New Mexico Univ., Albuquerque.
A STUDY OF THE PENETRATION OF PROJECTILES IMPACTING UPON SOIL AT LOW VELOCITIES
Wen L. Wang (Ph.D. Thesis) 1968 148 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-13085

A study of vertical penetration of projectiles into dry Ottawa sand is presented. Rigid right cylindrical projectiles were dropped normally into the sand at velocities less than 25 ft./sec. The penetration of the projectiles into Ottawa sand can successfully be predicted by an equation which was obtained from the assumption that the kinetic energy lost by the projectile is spent on imparting momentum to and overcoming the structural resistance of the sand mass. Fracturing of the sand particles is found to be negligible and is not included in the final conclusion. The penetration is found to be proportional to some power, less than one, of the weight of the projectiles. Dissert. Abstr.

N69-19885*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FINITE ELEMENT ANALYSIS FOR BUCKLING OF SEMIRIGID SPACE FRAMES

James Warren Ramsey, Jr. (M.S. Thesis—Va. Univ.) Jun. 1968 74 p refs
(NASA-TM-X-61465) Avail: CFSTI CSCL 20K

A theory for buckling of three-dimensional space frames by finite element methods is developed. A procedure for automation of buckling calculations is presented. An accuracy study is made of the convergence of the theory by finite difference methods and applied to the pinned, fixed, and cantilever column problems. The semirigid joints are introduced by a linear spring approach. Two- and three-dimensional numerical examples are presented that show the influence of semirigid joints on buckling loads. The procedure used to solve for the buckling loads in the examples is determinant plotting. The results for the problems studied show that practical moment resisting joints may be assumed to be rigid with a slightly nonconservative buckling load. Also, it is shown that practical moment free connections have a substantial amount of residual strength for buckling. Author

N69-19887*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESPONSE OF A PLASTIC CIRCULAR PLATE TO A DISTRIBUTED TIME-VARYING LOADING
Deene J. Weidman (Ph.D. Thesis—Va. Polytech. Inst.) Jun. 1968 104 p refs
(NASA-TM-X-61534) Avail: CFSTI CSCL 20K

The bending response of a plate to dynamic loading was studied. The restrictions made concerning the applied loading for the Tresca yield condition are removed. The plate is considered to be simply supported, and therefore, only one point (or circle) of discontinuity is considered to exist across the plate radius. The location of this circle of discontinuity is not generally constant but varies with time. The movement of this hinge circle is the key to solution of plastic plate problems under general loadings that vary with radius and time. The differential equation that defines the motion of the hinge circle is derived, and solved exactly for some cases. A short computer program is also presented that allows the numerical solution of the general non-linear differential equation for hinge circle location. Author

N69-19919 Purdue Univ., Lafayette, Ind.
THE CREEP BUCKLING OF VISCOELASTIC BEAM-COLUMNS
George Edward LaPrim (Ph.D. Thesis) 1968 160 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-12577

A study of the quasi-static, in-plane creep buckling of beam-columns made from viscoelastic materials is undertaken. The material is considered under isothermal conditions in both its linear and nonlinear ranges of behavior. Geometric nonlinearities are not included in the governing equations, precluding the treatment of post-buckling effects. In the linear range, the convolution integral form to the stress-strain equation, along with the classical Euler–Bernoulli theory, is used to formulate the governing integral-differential equation (integral with respect to time variation and differential with respect to spatial variation). In the nonlinear range, a stress-generalized strain equation is employed, which is a result of Schapery's extension of Biot's linear thermodynamic theory to a restricted type of nonlinear behavior. Dissert. Abstr.

N69-19920 Pennsylvania State Univ., University Park.
NATURAL FREQUENCIES AND STRAIN DISTRIBUTION IN A STIFFENED, THICK CYLINDRICAL SHELL
Jayantibhai Shivabhai Patel (Ph.D. Thesis) 1967 136 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-12001

An analytical investigation of the in-vacuo natural frequency and the strain distribution at resonance in a simply supported cylindrical shell which is reinforced by equally spaced ring stiffeners is presented. The analysis includes the effect of transverse shear strains, rotary inertia, and stress and strain normal to the reference surface. In the analysis, four different assumed mode shapes are used and their degree of accuracy is checked using experimental results. Lagrange's equations are used to derive the dynamic equations of the ring-stiffened shell. A good agreement between the analytical results and experimental results is obtained. For the shell considered, it is shown that the effect of tangential transverse shear strain is an important one. Dissert. Abstr.

N69-19932 California Inst. of Tech., Pasadena.
ON CONCENTRATED LOADS AND GREEN'S FUNCTIONS IN ELASTOSTATICS
Matias Jose Turteltaub (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-12765

This investigation is concerned with the notion of concentrated loads in classical elastostatics and related issues. Following a limit treatment of problems involving concentrated internal and surface loads, the orders of the ensuing displacements and stress singularities, as well as the stress resultants of the latter, are determined. These conclusions are taken as a basis for an alternative direct formulation of concentrated-load problems, the completeness of which is established through an appropriate uniqueness theorem. In addition, the present work supplies a reciprocal theorem and an integral representation-theorem applicable to singular problems of the type under consideration. Finally, in the course of the analysis presented, the theory of Green's functions in elastostatics is extended. Dissert. Abstr.

N69-19954 Purdue Univ., Lafayette, Ind.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF PRESTRESSED FOLDED PLATES
Fred Wayne Klaiber (Ph.D. Thesis) 1968 261 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 68-12575

General differential elasticity equations along with differential plate equations governing the action of lateral loads and forces in the middle plane of the plate have been employed in the formulation of the solution. These governing equations are then solved by employing the technique of finite-differences. To substantiate the analytical solution, experimental results from four strain gaged models are presented. Different loading arrangements are presented for each model and the results therefrom are compared with the corresponding analytical solutions. Details are also presented on an unsuccessful attempt to employ three-dimensional photoelasticity techniques as an experimental method of attack. Dissert. Abstr.

N69-19968*# Wyle Labs., Inc., Huntsville, Ala. Research Staff.
AN EXPERIMENTAL PROGRAM FOR THE INVESTIGATION OF PANEL INSTABILITIES CAUSED BY SHOCK WAVES
J. A. Cockburn Dec. 1968 19 p refs
(Contract NAS8-21100)
(NASA-CR-100354; TM-68-23) Avail: CFSTI CSCL 20K

Experiments designed to examine panel instabilities induced by step and wedge generated shock waves are outlined. Two distinct modes of panel instability are discussed: conventional panel flutter involving the lower panel modes, and shock-panel coupling involving the higher panel modes. The experimental approach described here consists of driving the panel with an impedance head while monitoring force, acceleration, and the phase lag between them; the magnitude of the phase lag gives a positive indication

of panel instability. Following an introductory review of panel instability modes, the experimental apparatus to be used for this investigation is described. Author

N69-19970 University of Southern Calif., Los Angeles.
RANDOM VIBRATION OF ELASTIC PLATE IN POTENTIAL FLOW OF FLUID
Hsueh-Chien Fu (Ph.D. Thesis) 1968 281 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 68-12033

The investigation of random vibrations of elastic plates submerged in moving fluids is presented. An exact analysis of the interaction between the plate of the fluid is presented within a linearized theory. The motion of the plate is described by the classical equations of thin plates and by a system of equations which take into account the transverse shear deformation and rotatory inertia. The motion of the fluid and the fluid forces acting on the plate are described by linearized potential theory. The loading acting on the plate is assumed as stationary and homogeneous random normal pressure. The general formulation of this work can be readily reduced to two special cases: instability (flutter) of a plate without normal loading and random vibrations of a plate in vacuum. Dissert. Abstr.

N69-20051 Virginia Polytechnic Inst., Blacksburg.
VIBRATION OF STRESSED SHELLS OF DOUBLE CURVATURE
Paul Ainhorn Cooper (Ph.D. Thesis) 1968 238 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.05 Order No. 68-12903

The effect of the meridional curvature on the natural vibrations of a class of axisymmetrically prestressed doubly curved shells of revolution was determined. A set of linear equations governing the infinitesimal vibrations is developed from Sander's nonlinear shell theory. A numerical procedure is given for solving the governing equations for the natural frequencies and associated mode shapes for a general shell of revolution with homogeneous boundary conditions. Matrix methods in finite difference form coupled with a Gaussian elimination were used to solve the governing equations of motion with constant coefficients which are based on shallowness of the meridian were developed as an alternate more rapid method of solution and solved in an exact manner for all boundary conditions. The effect of the meridional curvature on the fundamental frequencies of a class of cylindrical-like shells with shallow meridional curvature and freely supported edges were investigated. Results show that the positive Gaussian curvature shells have fundamental frequencies well above those of corresponding cyclindrical shells. Comparision of the membrane, pure bending and complete shell analyses showed that critical curvatures represent configurations at which the fundamental mode of vibration of the shell is in a state close to pure bending. The membrane theory affords a simple method of determining the modal wavelength ratio at which the pure bending state exists for a given negative Gaussian curvature shell, while the pure bending theory gives a good estimate of the magnitude of the frequency for this wavelength ratio. Dissert. Abstr.

N69-20056*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE RESPONSE OF A SINGLE WALL SPACE STRUCTURE TO IMPACT BY COMETARY METEOROIDS OF VARIOUS SHAPES
Robert J. Hayduk (M.S. Thesis—Va. Polytech. Inst.) May 1968 46 p refs
(NASA-TM-X-81527) Avail: CFSTI CSCL 20K

Linear, small deflection plate theory is used to study the stress at the contact axis and the deflection of an infinite plate caused by the impact of an axisymmetric cometary meteoroid. The analysis assumes that momentum exchange is the primary mechanism, that the time of exchange is instantaneous, and that the momentum of the meteoroid is negligible after impact. The stress at the origin is reduced to a single definite integral and the deflection to the Hankel inversion integral, both requiring definition of the particular projectile before further evaluation. A particular cometary meteoroid is mathematically represented in the analysis by its projected momentum per unit area onto the plate. The three specific shapes studied are the usual projectile shapes used in hypervelocity laboratories -- cylinder, cone, and sphere. Projectile comparisons based on equal mass, diameter, and total momentum indicate that frangible, low strength cone projectiles cause significantly higher stresses and larger displacements of the plate at short times after impact than similar sphere and cylinder projectiles. Author

N69-20057 Missouri Univ., Columbia.
THEORY OF FLEXURE OF ORTHOTROPIC MULTI-LAYER CIRCULAR SANDWICH PLATES
Fakhruddin Abdulhadi (Ph.D. Thesis) 1968 183 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 68-12479

The theory of flexure of multilayer orthotropic circular sandwich plates is obtained by extremizing the augmented complementary energy. The complementary energy is the sum of the strain energies of the individual layers minus the work done at the boundary of the plate. The constraint conditions which are imposed on the stresses and stress resultants and those dictated by the equilibrium equations of a differential element are used in conjunction with arbitrary Lagrange multipliers to augment the complementary energy. Several practical cases of plates with polar symmetric bending are solved to demonstrate the application of the pertinent equations and the proper boundary conditions. The bending of two hydrostatically loaded cases was obtained to demonstrate the application of the equations obtained for a nonpolar symmetric case. Curves are included to show the effect of shear and the degree of orthotropy on the deflection for several cases. Dissert. Abstr.

N69-20066 California Inst. of Tech., Pasadena.
ENERGY INEQUALITIES AND ERROR ESTIMATES FOR AXISYMMETRIC TORSION OF THIN ELASTIC SHELLS OF REVOLUTION
Chee Leung Ho (Ph.D. Thesis) 1968 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-12742

The analysis is carried out within the framework of the three-dimensional linear theory of elastic equilibrium for homogeneous, isotropic solids. The objective is the rigorous estimation of errors involved in the use of approximations based on thin shell theory. The underlying boundary value problem is one of Neumann type for a second order elliptic operator. A systematic procedure for constructing pointwise estimates for the solution and its first derivatives is given for a general class of second-order elliptic boundary value problems which includes the torsion problem as a special case. The method used here rests on the construction of energy inequalities and on the subsequent deduction of pointwise estimates from the energy inequalities. This method removes certain drawbacks characteristic of pointwise estimates derived in some investigations of related areas. Dissert. Abstr.

N69-20075# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
ADHESIVE BONDING FOR SPACE STATION APPLICATIONS

J. Mahon Dec. 1968 34 p
(FSR-AD8-05-68.2) Avail: Issuing Activity

This program was initiated to study on a laboratory scale the feasibility of vacuum bonding an 8-foot × 8-foot × 8-inch honeycomb sandwich structure. The ultimate goal of the program is the vacuum bag bonding of a 22-foot-diameter bulkhead. Sandwich panels up to about 2-feet × 2-feet in size were bonded using techniques closely approximating those comtemplated for the intermediate and 22-foot-diameter articles. Many of the 2219-T87 aluminum alloy skin materials were butt welded in the same manner as that proposed for the ultimate construction of the 22-foot-diamter sheet metal bulkhead. The results of flatwise tensile strength and beam flexure tests at room temperature indicate that vacuum bonding should be evaluated further through the fabrication of an 8 × 8-foot panel. The performance of the core splice material under vacuum bonding conditions was satisfactory. Author

N69-20118 Purdue Univ., Lafayette, Ind.
NONLINEAR BEHAVIOR OR ELASTIC SYSTEMS SUBJECTED TO FOLLOWER FORCES
Jack Cleveland Wiley (Ph.D. Thesis) 1968 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 68-12638

Some aspects of the nonlinear behavior of linearly elastic cantilevers subjected to nonconservative forces of the follower type are examined. Emphasis is placed on questions of the stability of such systems with the ultimate goal being a better understanding and extension of the information available from linear analyses. Nonlinear static formulations along the lines of the "elastica" problem are developed for two generalizations of the classical tangential follower—the inclined follower and lead-lag follower. Exact solutions are obtained for both problems. In order to study instabilities of the flutter type a nonlinear dynamical formulation of the inclined follower problem is developed. Since the governing partial differential equations are quite complex, approximate methods of solution are investigated. Dissert. Abstr.

N69-20159 Illinois Univ., Urbana.
THE INFLUENCE OF TRANSVERSE SHEAR ON THE SMALL DISPLACEMENT THEORY OF CIRCULAR PLATES
Terry Franklin Lehnhoff (Ph.D. Thesis) 1968 100 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 68-12151

This investigation is an analytical study of the effects of transverse shear on the small displacement theory of circular plates. The six governing coupled linear partial differential equations are derived. The resulting equations are solved for a wide class of problems. Any loading which satisfies the Dirichlet conditions of Fourier analysis and virtually any boundary conditions can be used. Most problems which can be solved using classical theory can also be solved by the methods presented with only a slightly greater amount of effort. The solution for the Reissner–Goodier theory presented is comparable in method to the solution of the biharmonic equation in polar coordinates of classical plate theory. Dissert. Abstr.

N69-20180# New York Univ., N. Y. School of Engineering and Science.
FINITE DEFORMATIONS OF A CYLINDRICAL MEMBRANE LOADED BY A UNIFORM INTERNAL PRESSURE AND AN AXIAL LOAD Interim Report
Harold Alexander May 1968 21 p refs
(Contract F19628-67-C-0241)
(AD-680822; NYU-AA-68-3; SR-3; AFCRL-68-0485) Avail: CFSTI CSCL 1/3

In order to determine the effect of the meridional stresses in a balloon gore on the film response in the circumferential direction, a long cylindrical elastic membrane subjected to uniform hydrostatic pressure and an axial load is analyzed. The analysis is first performed using a constitutive relation that assumes linearity between true stresses and Ludwik-Hencky (logarithmic) strains and then using a new non-linear constitutive relation developed by the author for neoprene film. The analysis using the linear constitutive relation predicts that the axial load has no effect on the value of the tensile instability pressure while the non-linear analysis predicts a significant effect. Experiments were performed with thin walled tubes of latex, an elastomer with a similar stress-strain response to that of neoprene. The findings agree with the results of the non-linear analysis. Author (TAB)

N69-20188*# New York Univ., N. Y.
ELASTIC ANALYSIS OF A LONG THIN CYLINDER AND CORE SUBJECTED TO AXISYMMETRIC RADIAL LOADS
Robert F. Melworm, Irwin Berman, and Bernard W. Shaffer Dec. 1968 82 p refs
(Grant NGR-33-016-067)
(NASA-CR-100277; S-68-4) Avail: CFSTI CSCL 20K

The problem of a long, thin cylinder on a core, subjected to a finite band of axisymmetric radial load is considered. The core is analyzed by elasticity theory. The cylinder is analyzed by thin-shell theory. Appropriate displacements and stresses are matched at the cylinder–core interface. After careful numerical evaluation of improper integrals, which appear in the solution, nondimensional displacement and stress ratios for the core and cylinder are presented for different widths of uniform pressure band load. A comparison to existing solutions for the limiting case of a line load is made and shows the maximum radial stress to be significantly larger than previously reported. It is also found that an increase in the band width from the limiting case of a line load decreases the stresses and displacements in the assembly significantly even though the external resultant force is kept constant. Author

N69-20213# California Univ., Berkeley.
STUDIES IN MECHANICS OF NONLINEAR SOLIDS Final Report, 23 Jan. 1964–23 Oct. 1968
J. Lubliner, K. S. Pister, and J. L. Sackman Nov. 1968 8 p refs
(Contracts DA-31-124-ARO(D)-460; DA-ARO(D)-31-124-G257)
(AD-680964; AROD-4547.44-E) Avail: CFSTI CSCL 20/11

The work performed under the project included a number of fundamental studies of the dynamic and quasistatic mechanical and thermomechanical behavior of a variety of solids: elastic, thermoelastic, viscoelastic (aging and nonaging), thermoviscoelastic, elasticplastic, and viscoplastic. The studies encompassed coordinated analytical, numerical and experimental investigations. This report lists the publications and the technical reports produced under the project. TAB

N69-20228# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE STABILITY OF CYLINDRICAL SHELLS, SUBJECTED TO EXTERNAL PRESSURE
V. V. Mykhailov May 1968 9 p refs Transl. into ENGLISH from Dopo. Akad. Nauk Ukr. RSR, Ser. A (Kiev), no. 2, 1967 p 170–172
(AD-681264; FTD-HT-23-31-68) Avail: CFSTI CSCL 20/11

An original process for manufacturing experimental cylindrical shells is proposed which provides for the perfect geometry and high mechanical properties of specimens, as well as a method and a device for their testing. The shells are produced by condensing

a vacuum-evaporated metal (in this experiment it was pure copper) on the highly polished inner surface of a hollow cylinder. The vacuum-chamber set up and the process of coating are described and are illustrated by a schematic diagram, stressing the homogeneous structure, uniform thickness, and high elastic limit of the shells produced. The installation for testing the simply supported shells (80 mm in diameter, 80 mm long, 0.04–0.08 mm wall thickness) is also described and its arrangement is sketched. The techniques used in testing are discussed, and the buckling behavior of shells is analyzed. The results of theoretical (by O. V. Pogorelovs method) and experimental investigations of the lower value of the buckling force are presented and compared graphically with each other. They show a fair agreement. The appearance of plastic deformations in shells with wall thickness over 0.09 mm is mentioned, and the discrepancies up to 25–30% between the experimental and theoretical values of the buckling force are indicated. Author (TAB)

N69-20229# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
WELDED CONTINUOUS FRAMES AND THEIR COMPONENTS Final Report, 22 Jan.–2 Nov. 1968
Dec. 1968 7 p
(Contract N00024-68-C-5228)
(AD-681205; REPT-273.3) Avail: CFSTI CSCL 13/13

The topic of the investigation has been the plastic behavior of welded multi-story frames and their components, and the development of design methods for such frames based on plastic strength. Author (TAB)

N69-20237*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
ON THE STABILITY OF SOME CONTINUOUS SYSTEMS SUBJECTED TO RANDOM EXCITATION
R. H. Plaut and E. F. Infante [1968] 32 p refs
(Grants NGL-40-002-015; AF-AFOSR-693-67; Contract DA-31-124-ARO(D)-270)
(NASA-CR-100369) Avail: CFSTI CSCL 20K

A method for the determination of sufficient conditions for the almost sure stability of some continuous systems of physical interest is presented. The motions of the systems under consideration are assumed to be described by linear partial differential equations with time-varying coefficients of a random nature. The method presented is restricted for the sake of simplicity and ease of computations and is applied to problems of elastic columns and plates, a centilever beam subjected to a random follower force, and a string excited by a pressure-type random force. The emphasis in the computations and in the nature of the method is on simplicity of computations and in the determination of stability conditions with a minimum of assumptions. Author

N69-20256# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Special Projects Section.
FREE VIBRATIONS OF REINFORCED ELASTIC SHELLS
Hyman Garnet and Alvin Levy Mar. 1969 42 p refs
(RE-357) Avail: Issuing Activity

A technique is presented for the analysis of a wide class of reinforced elastic structures undergoing free vibrations while subject to constraints imposed by the reinforcing elements. The technique consists of replacing the constrained structure by an equivalent model, a structure without reinforcing elements, undergoing free vibrations while subject to a loading system which consists of the structure-reinforcing element interaction forces. These forces are introduced as displacement-dependent loads, whose magnitudes reflect the elastic and inertial properties of the reinforcing elements. The displacements of the constrained body are expanded in terms of the normal modes of the unconstrained body. This approach leads to a set of manageable governing equations describing the behavior of the reinforced body exactly. A solution to these equations may then be obtained to any desired degree of accuracy. The technique is illustrated by computations performed for the case of a ring-reinforced circular cylindrical shell. Author

N69-20261# Laval Univ. (Quebec). Dept. of Civil Engineering.
ANALYSIS OF CIRCULAR CONOIDS
Avinash C. Singhal and Marcel Gagnon 1 Feb. 1969 47 p refs
Avail: CFSTI

A general numerical procedure is presented for the analysis of circular conoids undergoing bending deformation. The influence of rise, length, thickness, Poisson's ratio and mesh size over the stress quantities of the shell are investigated. A set of two governing partial differential equations is reduced to a stiffness matrix type formulation using linear central finite difference techniques. The shell deflections and finally the stresses are obtained by using the flow-graph method of solution. Nineteen different simply supported circular truncated conoids, subjected to uniformly distributed loads, were numerically analyzed. The results show that the maximum radial deflections for geometrically similar conoids with various rises always occur at a constant distance from the mid-length point and closer to the lower rise end. The maximum radial deflections for conoids with various lengths always occur at various distances away from the mid-length point and closer to the low rise end. Author

N69-20268# Laval Univ. (Quebec). Dept. of Civil Engineering.
NONLINEAR DYNAMIC RESPONSE OF BONDED AND UNBONDED RINGS UNDER HIGH INTENSITY BLASTS
Avinash C. Singhal and Gerard Bonnes Jun. 1968 95 p refs
(S-9) Avail: CFSTI

A general numerical procedure for solving the non-elastic dynamic response of multilayered multiring structures, with different tensile and compressive properties, is developed. The procedure can predict the nonlinear response of bonded and colliding unbonded multirings subjected to high intensity impulsive loadings. The stress–strain relationship of a ring material is approximated by a multilinear diagram which represents an elasto-plastic, strain-hardening, and strain rate sensitive type behaviour. Dynamics of collision is incorporated in the analysis by allowing an exchange of linear and angular momentum and energy between the rings. A cyclic timewise solution of the reduced finite difference equilibrium equations is accomplished by using elimination and incremental type methods. The influences of mesh size, number of subflanges, and various other parameters on the accuracy of the results are investigated. Author

N69-20269# Laval Univ. (Quebec). Civil Engineering Dept.
NUMERICAL ANALYSES OF CIRCULAR CONOID SHELL STRUCTURES
Avinash C. Singhal and Marcel Gagnon Jan. 1969 126 p. refs
(S-14) Avail: CFSTI

A general numerical procedure is presented for the analysis of circular conoids undergoing bending deformation. The influence of rise, length, thickness, Poisson's ratio and mesh size over the stress quantities of the shell are investigated. A general set of governing equilibrium differential equations for shallow thin shells is derived. These equations are valid for any shape of shell. It is found that these governing equations have striking similarities to Vlasov's equations for shallow thin shells. The governing partial differential equations are reduced to a stiffness matrix type formulation using linear central finite difference techniques. The shell deflections and

finally the stresses are obtained by using the flowgraph method of solution and using the third generation IBM 360 computer. Nineteen different simply supported circular truncated conoids, subjected to uniformly distributed loads, were numerically analyzed. Author

N69-20294# Laval Univ., (Quebec). Applied Mechanics Section.
THE USE OF FINITE ELEMENT METHODS FOR STATIC AND DYNAMIC ANALYSES OF COMPLEX SHELLS Lecture Material
A. C. Singhal, comp. Dec. 1968 80 p refs
(S-13) Avail: CFSTI

The basic steps involved in applying the finite element displacement method to a linear elastic solid are studied. The procedure for plane stress and plane strain is specialized and the appropriate matrices for the simplest triangular element are developed. The problem of formulation is done in the following manner: (1) The continuum is separated by imaginary lines or surfaces into a number of finite elements. (2) The elements are assumed to be interconnected at a discrete number of nodal points situated on their boundaries. (3) A function is chosen to define uniquely the state of displacements within each element in terms of its nodal generalized displacements. (4) The generalized displacement functions now define uniquely the state of strain within an element, in terms of the generalized nodal displacements. (5) A system of forces concentrated at the nodes and equilibrating the boundary stresses and any distributed loads is determined, resulting in a stiffness relationship similar to that used in frame analysis. Author

N69-20313 Illinois Univ., Urbana.
ANALYSIS OF SIMPLE AND COMPOUND REPEATED STRUCTURES
Thomas James McDaniel (Ph.D. Thesis) 1968 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 68-12186

A difference equation technique was developed to obtain the frequency response functions of a beam type structure, the interior of which forms a pattern of repeating basic units. These frequency response functions are required to compute the response statistics of the structure to random excitation. The technique developed is useful for the analysis of flat aircraft panels with tuned-damper attachments. Both simple and compound repeated structures are considered. A compound repeated structure is one that is composed of basic units which are themselves repeated structures. This difference equation analysis has the same advantages as those of the transfer matrix analysis in that it can simply account for boundary conditions, localized damping devices, and excitations. It further leads to results in simple form which are convenient in the effect of various parameters on the response of a structure. In contrast to the transfer matrix analysis, better numerical accuracy and smaller computer storage requirements are inherent in the difference equation analysis since only the final step in the analysis requires numerical operations. Dissert. Abstr.

N69-20339# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
FURTHER INFORMATION ON THE DETERMINATION OF SHELLS BEYOND THE ELASTIC RANGE [COMPLEMENTS A UNE THEORIE DES COQUES HORS DU DOMAINE ELASTIQUE]
Roger Valid [1968] 41 p refs In FRENCH; ENGLISH summary
(ONERA-NT-126 AVAIL: CFSTI

A first study has defined a method of calculating shells of any shape in large displacements and deformations. A particular case is presented here, which takes into account the non-planar deflection of the normals. Some consequences of the kinematic assumptions are added, in a simple intrinsic form; they concern the indeterminate strains, the homo-kineticity conditions and the kinematic compatibility conditions, as well as some considerations on the semi-global methods. Author

N69-20392# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OSCILLATIONS OF A SYSTEM WITH NONLINEAR CHARACTERISTIC UNDER THE INFLUENCE OF A RANDOM FORCE
M. F. Dimentberg May 1968 11 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 2, no. 10, 1966 p 10–15
(AD-681266; FTD-HT-23-05-68) Avail: CFSTI CSCL 20/11

A combined probability density was found for the velocity and acceleration of a system in a generalized coordinate, with piecewise linear characteristic, situated under the effects of an exponentially-correlated arbitrary perturbation. An estimate is given for the error of approximated value of the mean square of acceleration in a system with continuous characteristic, having a limited derivative. TAB

N69-20399# College of Aeronautics, Cranfield (England). Dept. of Materials.
SOME FURTHER EXPERIMENTS IN FATIGUE TESTING AT 20 kHz
B. S. Hockenhull Oct. 1968 16 p refs
(CoA-Note-Mat-24) Avail: CFSTI

Considerations are made of the suitability of acoustic transformers applied to fatigue testing at 20 kHz. A suitable system has been constructed which allows the use of plain cylindrical specimens. The results of fatigue tests on an aluminum alloy are given and discussed in relation to structure and environment. Author

N69-20428# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
LOW FREQUENCY EXTENSIONAL VIBRATIONS OF THIN ANISOTROPIC DISCS Interim Technical Report
R. K. Kaul Aug. 1968 70 p refs
(Contract DA-28-043-AMC-01731(E))
(AD-681348; ECOM-01731-2; ITR-2) Avail: CFSTI CSCL 20/11

In this paper use is made of the theory of perturbation for solving an eigenvalue problem in anisotropic elasticity. Using the concept of the nearest isotropic tensor, the eigenvalues of our original problem are approximated in terms of the known eigenvalues of the isotropic problem. Explicit perturbation formulas are given and it is shown how they differ from well-known formulas. Finally, the problem of contour vibrations of a circular AT-type quartz disk is treated in detail, and it is shown that the formulas developed herein lead to a convergent sequence of eigenvalues. The phenomenon of bifurcation of eigenvalues is also explained. Author (TAB)

N69-20437# Aeronautical Research Council (Gt. Brit.)
AN INVESTIGATION OF STRESS REDISTRIBUTION CAUSED BY CREEP IN A THICK-WALLED CIRCULAR CYLINDER SUBJECTED TO AXIAL AND THERMAL LOADING
J. M. Clarke 1969 55 p refs Supersedes NGTE-R289; ARC-29484
(ARC-CP-1024; NGTE-R289; ARC-29484) Avail: CFSTI

A thick-walled tube was subjected to an axial load and a radial temperature distribution which caused thermal stresses. The creep strains and the eventual rupture times were observed and

compared with conventional creep tests and theoretical analysis. Theory suggested and experiments confirmed that stress redistribution caused the overall strain behaviour to approach that for the mean axial stress and the mean radial temperature. Description of the experimental technique and apparatus includes a novel and simple optical extensometer. Appendices contain a complete analytic treatment of the triaxial stress problem in a long thick tube in the presence of an arbitrary distribution of non-elastic strains, and a treatment of some conditions under which stress-redistribution calculations can lead to a 'steady state' or 'fully redistributed' stress pattern. A less rigorous theoretical treatment which ignores radial constraints is shown to lead to an under-estimate of the thermal stresses and of the time required for stress redistribution to occur. Author (ESRO)

N69-20443# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.

CONTACT STRESS AND CRACK PROBLEMS IN THE MATHEMATICAL THEORY OF ELASTICITY Final Report, 19 Apr. 1965–1 Dec. 1968

Leon M. Keer Dec. 1968 8 p refs

(Contract DA-31-124-ARO(D)-369)

(AD-680970; AROD-5527-11-E) Avail: CFSTI CSCL 20/11

Certain analytical problems of engineering and mathematical significance in the three-dimensional theory of elasticity have been solved. Solutions to these problems, in addition to their academic challenge, have proven to be useful in making design estimates. Particular problem areas investigated include the following: Thermoelastic contact problems; Problems involving torsion of structural members in contact; A study of cracks in a medium undergoing simple shear; A study of punch and crack problems involving adhesion. TAB

N69-20488# Stanford Univ., Calif. Dept. of Applied Mechanics.

ELASTIC-PLASTIC BOUNDARIES IN PLANE AND CYLINDRICAL WAVE PROPAGATION OF COMBINED STRESSES Interim Technical Report

T. C. T. Ting Dec. 1968 20 p refs

(Contract DA-04-200-AMC-659(X))

(AD-680809; BRL-CR-16; TR-194) Avail: CFSTI CSCL 20/11

A general study is given of plane and cylindrical wave propagation of combined stresses in an elastic-plastic medium. The coefficients of the governing differential equations, when written in matrix notation, are symmetric matrices and can be divided into sub-matrices each of which has a special form. The relations between the stresses on both sides of an elastic-plastic boundary are derived. Also presented are the restrictions on the speed of an elastic-plastic boundary. Author (TAB)

N69-20642# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuttgart (West Germany).

MATRIX ANALYSIS OF SHELLS—SMALL AND LARGE DISPLACEMENTS Final Scientific Report, Jan. 1965–Dec. 1966

John H. Argyris and J. B. Spooner, ed. Nov. 1968 223 p refs

(Contract AF 61(052)-854)

(AD-681153; ISD-40; AFFDL-TR-67-197) Avail: CFSTI CSCL 20/11

A short resume of the matrix displacement method of structural analysis is given and followed by some essential matrix transformations. The stiffness matrices of parallelogram, rectangular and triangular bending elements are developed followed by extensions to consider also membrane stresses. A kinematically consistent idealization of pressure loadings is presented, and the extension of the matrix displacement method to large displacement problems considered. Matrix eigenvalue problems arising in buckling, free vibration and damped vibration are considered and algorithms described for the determination of eigenvalues. Some examples are presented. TAB

N69-20652# Aeronautical Research Council (Gt. Brit.)

A COMPARISON OF SOME METHODS FOR PREDICTING CREEP STRAIN AND RUPTURE UNDER CYCLIC LOADING

J. M. Clarke 1968 23 p refs Supersedes NGTE-R-228; ARC-29498

(ARC-CP-1020; NGTE-R-228, ARC-29498) Copyright. Avail: CFSTI; HMSO 4s 6d

There are many good reasons for attempting to predict creep behaviour under conditions of varying stress and temperature from data derived from tests performed at constant stress and temperature. This report starts by describing the most straightforward hypotheses at present used for this purpose. Computed results for cyclic variations have shown that i) the 'strain hardening' and 'life fraction' hypotheses predict very similar rupture times, ii) the times to a given creep strain do not depend on the frequency of the cycles or the sequence of loading within the cycles providing there are several (10 or more) cycles involved, iii) when a substantial proportion (more than about two-thirds) of the creep life shows a 'tertiary' behaviour the 'time hardening' hypothesis predicts the shortest rupture times for the same cyclic loading. A method is demonstrated for evaluating effective mean stresses or temperatures for any cyclic conditions according to either strain or time hardening hypotheses. Author (ESRO)

N69-20654# Laval Univ. (Quebec). Dept. of Civil Engineering.

NONLINEAR DYNAMIC RESPONSE OF BONDED AND UNBONDED RINGS UNDER HIGH INTENSITY BLASTS Final Report

A. C. Singhal May 1968 98 p refs Prepared for CARDE

(Grants DRB-G-1601-29; NRC A-2940)

(DRB-1601-29) Avail: CFSTI

A general numerical procedure for solving the non-elastic dynamic response of multi-layered multi-ring structures, with different tensile and compressive properties, was developed. The procedure predicts the non-linear response of bonded and colliding unbonded multi-rings subjected to high intensity impulsive loadings. The stress–strain relationship of a ring material was approximated by a multi-linear diagram which represented an elasto-plastic, strain-hardening, and strain rate sensitive type behavior. Dynamics of collision were incorporated in the analysis by allowing an exchange of linear and angular momentum and energy between the rings. A cyclic time-wise solution of the reduced finite-difference equilibrium equations was accomplished by using elimination and incremental type methods. The influences of mesh-size, number of subflanges, and various other parameters on the accuracy of the results were investigated. Agreement within 1% was obtained for four subflanges when compared with two subflanges. Author

N69-20661# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

ON PLATES SEALING AN INCOMPRESSIBLE LIQUID

Arnold D. Kerr Nov. 1968 18 p refs

(AD-681212; CRREL-RR-280) Avail: CFSTI CSCL 8/12

After a brief description of the circumstances which led to the investigation of the title problem and discussion of some related previous investigations, exact solutions are derived for a circular plate which seals an incompressible liquid, is clamped along the boundary and is subjected at an arbitrary point to a lateral concentrated force P. For the case when the plate is covered by

a thin liquid layer the solution is obtained in closed form. When this liquid layer is absent, the solution is obtained as an infinite series. The paper concludes with a study of the range of the parameter (lambda a) for which the effort of buoyancy is negligible upon the deflections and stresses in the plate. Author (TAB)

N69-20671# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
POSTBUCKLING OF AN AXIALLY COMPRESSED OVAL CYLINDRICAL SHELL
Joseph Kempner and Youl-Nan Chen Nov. 1968 36 p refs
(Contract AF 49(638)-1360)
(AD-681140; PIBAL-68-31; AFOSR-68-1994) Avail: CFSTI CSCL 13/13

A previous analysis (See AD-635 481 and AD-657 898) of the postbuckling of axially compressed noncircular (oval) cylindrical shells is extended. Additional results showing that, in contrast to the circular cylinder, such a shell may be capable of carrying postbuckling loads substantially higher than its classical buckling load are presented. Furthermore, a perturbation solution, applied to the equations determined from the conditions of stationary total potential energy, yield linear algebraic equations appropriate for the determination of postbuckling characteristics in the initial postbuckling region. It is found that postbuckling load-shortening curves not only exhibit an initial load decrease, but, for the most part, also branch from the bifurcation point towards the third quadrant. Despite the initial drop, these curves also reveal an increase of the load toward the relative maximum load. Furthermore, experimentally determined curves for oval cylinders of Mylar, which exhibit the initial drop, the subsequent rise, and the maximum postbuckling load, are presented. These results are in reasonably good agreement with those determined from the nonlinear theory. Author (TAB)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N69-19628# Union Carbide Corp., Tonawanda, N. Y. Linde Div.
RESEARCH AND DEVELOPMENT IN A THERMAL INSULATION STUDY Quarterly Progress Report, Jun.–Aug. 1968
F. Notaro and W. E. Grunert Aug. 1968 100 p refs
(Contract AT(30-1)-3632)
(ALO-3632-33) Avail: CFSTI

Long-term thermal conductivity tests are currently in progress on four multi-layer systems operating at temperatures from 1400 to 1800°F. Thermal conductivity data and correlation coefficients are summarized for all multi-layer insulation systems studied. Thermal conductivity data (flat plate testing) are presented for four multi-foil insulations for service to 1400°F and four opacified or nonopacified fibrous multi-layer insulations. The methods for correlating thermal performance to temperature and mechanical load (layer density) are discussed. The correlation coefficients based on experimental data are presented. A modified flat plate testing fixture, providing for simultaneous compression of sample and guard in thermal conductivity testing of mechanically loaded samples, is described. A brief flat plate error analysis is presented and an estimated error band on experimental data is given. Author (NSA)

N69-19629# Aktiebolaget Atomenergi, Stockholm (Sweden).
CALCULATION OF VOID VOLUME FRACTION IN THE SUBCOOLED AND QUALITY BOILING REGIONS
S. Z. Rouhani and E. Axelsson Oct. 1968 24 p refs
(AE-336) Avail: CFSTI

The complex problem of void calculation in the different regions of flow boiling is described in two divisions. The first part includes only the description of the mechanisms and the calculation of the rates of heat transfer for vapour and liquid. It is assumed that heat is removed by vapour generation, heating of the liquid that replaces the detached bubbles, and in some parts, by single phase heat transfer is obtained. An equation is given for the differential changes in the true steam quality throughout the boiling regions by considering the rate of vapour condensation in liquid. Integration of this equation yields the vapour weight fraction at any position. The second part of the problem concerns the determination of the void fractions corresponding to the calculated steam qualities. For this purpose earlier published derivations by Zuber and Findlay were used. This model is compared with data from different geometries including small rectangular channels and large rod bundles. NSA

N69-19694*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SIMPLIFIED EQUILIBRIUM HYDROCARBON-AIR COMBUSTION GAS MODEL FOR CONVENIENT USE IN AIR-BREATHING ENGINE CYCLE COMPUTER PROGRAMS
Vincent R. Mascitti (M.S. Thesis—Va. Univ.) [1968] 51 p refs
(NASA-TM-X-61530) Avail: CFSTI CSCL 20M

A simplified hydrocarbon-air combustion gas model, including the effects of dissociation, for conventient use in engine cycle computer programs is presented. The generalized model reduces to the hydrogen-air system as well as dissociating air. The exclusion of chemical species containing atomic nitrogen allows a considerable simplification of the composition equations. The thermodynamic properties of stoichiometric combustion of the kerosene-air and hydrogen-air systems are computed with the simplified model and compared with more comprehensive gas models. In addition, the effect of the neglected chemicals species on the performance of a idealized subsonic combustion ramjet is presentad. The simplified gas model has been used to define the limiting conditions for solid carbon and ammonia formation for fuel rich gas mixtures. A computer program listing of the simplified gas model calculation procedure is presented. Author

N69-19696*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY OF THE SIMULATION OF THE FLIGHT PERFORMANCE OF CHARRING ABLATORS IN GROUND FACILITIES
Stephen S. Tompkins (M.S. Thesis—Va. Polytech. Inst.) Jun. 1968 73 p refs
(NASA-TM-X-61509) Avail: CFSTI CSCL 20M

An analytical and experimental investigation has been made to evaluate a technique by which the performance of charring ablators in high enthalpy environments can be determined by testing in low enthalpy environments. Relationships are presented which indicate that proper simulation of a high enthalpy environment can be achieved by adjusting the heat input and stream oxygen content in the low enthalpy environment. Tests with a high and a low density phenolic nylon charring ablator were made at two enthalpy levels to validate the simulation technique. Values of the principal test parameters in the high enthalpy environment and the low enthalpy test environment were, respectively, enthalpy, 1000 and 3000 Btu/lbm, cold-wall convective heating rates, 170 and 160 Btu/ft^2 sec, stream oxygen mass fraction 0.23 and 0.05. A

comparison of the ablation performance data indicates that satisfactory simulation was obtained. Author

N69-19749# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
ANALYTICAL EXPRESSIONS FOR THE THERMODYNAMIC PROPERTIES OF DENSE NITROGEN
S. Culotta and K. R. Enkenhus Sep. 1968 50 p refs
(VKI-TN-50) Avail: CFSTI

Analytical expressions are given for the thermodynamic properties of undissociated dense nitrogen. These properties, which include the internal energy, enthalpy, entropy, compressibility, sound speed and specific heats, are obtained with the help of the equation of state using thermodynamic relations. Two semi-empirical equations of state are used, which were selected after a critical examination. The one is applied at densities below the critical value, the other, at higher densities. These equations fair smoothly together at the critical density in such a way that the derived thermodynamic properties are continuous as the density passes through the critical value. The equations are expressed in terms of reduced variables, that is, the pressure, density and temperature are made dimensionless by dividing by the corresponding values at the critical point. The constants appearing in the equations of state were selected to provide the best agreement of the resulting thermodynamic properties with the AEDC tables for dense nitrogen of Grabau and Brahinsky (AEDC-TR-66-69). The analytical expressions for the thermodynamic properties of nitrogen agree with the AEDC tables within better than one percent on the average at all densities up to 1000 amagats and temperatures from 300°K to 5000°K. Author (ESRO)

N69-19757# Aeronautical Research Council (Gt. Brit.).
HEAT TRANSFER IN A TUBE REVOLVING ABOUT A DISPLACED AXIS
J. F. Humphreys (Liverpool Univ.) 3 Oct. 1968 14 p refs
(ARC-30561) Avail: CFSTI

Consideration is given to heat transfer and fluid flow in the entry region of a tube revolving about a displaced axis parallel to the tube axis. Experimental results indicate that both inherent swirling flow and centrifugal buoyancy contribute to increases in heat transfer as a result of rotation. Author (ESRO)

N69-19802 Minnesota Univ., Minneapolis.
THE THERMAL CONDUCTIVITY OF STATIONARY AND FLOWING SUSPENSIONS
Avtar Singh (Ph.D. Thesis) 1968 200 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 68-12287

The thermal conductivity of neutrally buoyant suspensions is shown to decrease with the increasing particle concentration and to satisfy Maxwell's formula up to the investigated concentration 40%. However, the thermal conductivity of non-neutrally buoyant suspensions is shown to be higher than predicted by Maxwell's formula. This is attributed, a priori, to the wake created by gravity settling of particle assemblages. The pressure drop measurements for suspensions (prepared in aqueous glycerine), obtained in 1 mm tube, showed that the velocity profile is parabolic for concentrations up to 11%, whereas the profile becomes blunted for 20% particle concentration. The augmentation in thermal conductivity has been shown to occur in suspensions in laminar motion and has been attributed to the liquid churning caused by the spinning particle in shear flow. Dissert. Abstr.

N69-19833# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
STUDY OF THE HEAT DIFFUSION PROBLEM IN A TRANSIENT REGIME FOR A MULTIREGION SYSTEM WITH TRANSFORM INTEGRAL [STUDIO DI UN PROBLEMA DI DIFFUSIONE DEL CALORE IN REGIME TRANSITORIO PER UN SISTEMA MULTIREGIONI COL METODO DELLA TRASFORMATE INTEGRALI]
G. Papa 1968 17 p refs In ITALIAN
(RT/FIMA(68)6) Avail: CFSTI

The dynamic heat diffusion equations in a multiregion system are analysed. The mathematical problem is represented by a p.d. e system for the spatial variable x and time variable t. The solution is obtained through weighted average spatial variables, represented by finite integral transform. The kernel of this integral transform is obtained considering the diffusion operator properties and temperature and flux interface and boundary conditions. Author

N69-19847# Library of Congress, Washington, D. C. Aerospace Technology Div.
RADIATIVE TRANSPORT COOLING OF ROCKET ENGINES
Anatol Surak *In its* Foreign Sci. Bull., vol. 5, no. 2 Feb. 1969 p 46-64 refs (See N69-19843 09-34)
Avail: CFSTI

Soviet investigations of radiative transport cooling and its possible application to liquid rocket engines are reviewed. Author

N69-19901*# Techtran Corp., Glen Burnie, Md.
AN EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER IN THE NOZZLE OF HIGH-ALUMINIZED SOLID ROCKET (EFFECTS OF ALUMINUM ADDED TO PROPELLANT)
Tomifumi Godai et al Washington NASA Feb. 1969 16 p refs Transl. into ENGLISH from Japanese Rept. TR-147
(Contract NASw-1645)
(NASA-TT-F-12106; TR-147) Avail: CFSTI CSCL 20M

An experimental study was made of the heat transfer in a solid rocket mortar nozzle using a polybutadiene system composite propellant containing aluminum. It was found that the rate of heat transfer increases markedly as the aluminum content in the propellant is increased, and that the effect of heat radiation of alumina particles was small. Moreover, in computing the heat transfer, the combustion gas flow containing alumina particles was treated as a single gas phase flow having mixed phases and equivalent specific heats, and it was found that the results of computation obtained by applying the semi-theoretical equation pertaining to turbulent flow heat transfer within a tube matches well with the experimental values. Author

N69-19943 Minnesota Univ., Minneapolis.
CHLORINE-FLUORINE FLAME STUDIES
Lawrence Lacy Ambs (Ph.D. Thesis) 1968 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 68-12231

Spatial velocities were measured using the tube technique. Fundamental flame speeds were measured on a flat flame burner. The fundamental flame speed in an equimolar mixture was 93 ± 5 cm/sec. The maximum computed adiabatic flame temperature was 1400°K in a 48.3% fluorine mixture. A two diffraction grating interferometer was used to study the structure of a chlorine-fluorine-argon flat flame. The measured refractive index profile was used to compute a temperature profile through the flame zone. The maximum temperature was within experimental error of the computed adiabatic flame temperature of 1073°K. The reaction rate measured by Dahneke at low temperatures could not be used

in these flames to compute the composition profiles in the flame zone. Instead a Lewis number of unity was assumed, and the temperature profile was used to compute the composition in the flame zone. The high flame speeds and low flame temperatures suggest that an effective thermal conductivity may be important in determining the flame speeds in these mixtures. Dissert. Abstr.

N69-20007 New Mexico Univ., Albuquerque.
DIRECTIONAL EFFECTS IN RADIANT HEAT TRANSFER BETWEEN PAIRS OF SIMPLY ARRANGED SURFACES
C. H. Treat (Ph.D. Thesis) 1968 164 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-13083

Heat transfer rates are calculated between symmetrically oriented pairs of isothermal, parallel and non-parallel rectangular plates. The calculations are conducted in detail for three different non-conducting materials and six different geometries. Heat rates for each combination of these materials and geometries are determined using four bi-directional reflectance models: diffuse, specular, combination diffuse plus specular, and the model developed by Torrance and Sparrow. The method employed in obtaining the results is that of following the emitted energy as it undergoes the multiple steps of absorption and reflection back and forth between the plates. Dissert. Abstr.

N69-20008*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THERMAL CONDUCTION THROUGH AN EVACUATED IDEALIZED POWDER OVER THE TEMPERATURE RANGE OF 100 DEG K TO 500 DEG K
Ronald B. Merrill Washington Mar. 1969 82 p refs
(NASA-TN-D-5063) Avail: CFSTI CSCL 20M

Measurement of the radiative thermal conduction of an ideal powder as a function of temperature was conducted to find a suitable experimental method. Three classes of techniques were investigated: steady state, probe, and pulse. A hybrid type, the differential line heat source method, was selected and applied to spherical barium silicate glass beads with sample sizes of 10μ to 20μ, 38μ to 53μ, and 125μ to 243μ, in a vacuum of at least 2×10^{-6} torr. Various statistical treatments of the data as well as the raw data itself are discussed and compared as to probable accuracy. Previous work in this area is reviewed and an equation to describe the conductivity–temperature relationship of the form $K = AT^3 + B$ proposed. K.R.G.

N69-20017 Oklahoma Univ., Norman.
RADIATIVE HEAT TRANSFER FROM AN ARBITRARY PLANE SOURCE TO A SEMI-INFINITE AEROSOL
Gordon Lloyd Scofield (Ph.D. Thesis) 1968 288 p
Avail: Univ. Microfilms: HC $13.05/Microfilm $3.70 Order No. 68-13254

Radiative heat transfer directly to the droplets of a semi-infinite aerosol located above a finite plane area source is analyzed in this work. A practical orientation is maintained during the analysis by considering the problem of evaporating the water droplets in a natural fog located over an airport runway. The departures of this work from that of previous investigations include multiple anisotropic scattering, and the use of a relatively large finite source at a relatively low temperature to effect heat transfer to the surrounding fog. Dissert. Abstr.

N69-20019 Minnesota Univ., Minneapolis.
ELECTRODE HEAT TRANSFER STUDY IN A MAGNETO-PLASMA-DYNAMIC ARC
Kwang-Tien Shih (Ph.D. Thesis) 1968 104 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-12285

Experiments are performed to measure the electrode heat transfer of a magneto-plasma-dynamic (MPD) arc. Two different axially symmetric anode configurations are used: a solid cylindrical anode for the measurements of total quantities, and a longitudinally segmented anode for "local" measurements. Experimental versions of MPD arc thrustors have been operated in a low pressure environment maintained in a water cooled vacuum chamber. Argon and ammonia are used as working fluids over a range of arc currents, mass flow rates, chamber pressures and magnetic field strengths. A simple anode heat transfer model is proposed and confirmed by the experimental data, which show that there is a linear relationship between the anode heat fluxes and the arc current. Dissert. Abstr.

N69-20039 Yale Univ., New Haven, Conn.
MAGNETIC PHASE TRANSITIONS IN RARE EARTH INSULATORS
David Paul Landau (Ph.D. Thesis) 1968 371 p
Avail: Univ. Microfilms: HC $16.90/Microfilm $4.75 Order No. 68-13175

Magnetic phase transitions are studied in two rare earth systems, $CeCl_3$ and dysprosium aluminum garnet (DAG). Several different types of magnetothermal measurements are used to obtain information about the bulk thermal and magnetic properties of the systems. These results are then used to determine the size (although not the origin) of the spin–spin interaction parameter. Measurements of the zero field specific heat and susceptibility show that $CeCl_3$ undergoes a cooperative phase transition at 0.268°K to an antiferromagnetic ordered state. Analysis of the high temperature specific heat and susceptibility is combined with ESR pair results to find the interaction constants. However, because of the symmetry of the lattice, we are unable to predict a unique, stable ordered spin arrangement. Dissert. Abstr.

N69-20058 Southern Methodist Univ., Dallas, Tex.
AN EXPERIMENTAL INVESTIGATION OF INDIVIDUAL DROPLET HEAT TRANSFER RATES DURING SPLATTERING FROM A HEATED, INCLINED SURFACE
Francis Kamp McGinnis, III (Ph.D. Thesis) 1967 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-11844

Values of heat transfer per droplet were determined for small droplets of water, ethanol, and acetone striking a nickel-plated copper test surface. Surface temperatures ranged from 150° to 500°F above saturation. Droplet size, impact velocity, and angle of incidence were varied. The quantity of heat transferred from the surface to the fluid during the splattering process exhibits a very definite maximum with respect to surface temperature. This maximum occurs at a saturation temperature excess of approximately 300°F for the substances tested. Experimental observations and the results of a simplified analysis indicate that this maximum is a result of the opposing effects of increasing thermal gradient and decreasing droplet contact time. The efficiency of the process, defined as the ratio of actual heat transfer per drop to maximum possible heat transfer per drop, is on the order of 50% for a single collision. The effect of impact angle can be satisfactorily accounted for by use of the normal component of impact velocity. Dissert. Abstr.

N69-20070# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
ON HOWARD'S UPPER BOUND FOR THE HEAT TRANSPORT BY TURBULENT CONVECTION

F. H. Busse Jun. 1968 43 p refs
(MPI-PAE/ASTRO-8/68) Avail: CFSTI

The variational problem formulated by Howard for the derivation of an upper bound on the heat transport by convection in a layer heated from below is analyzed for the case when the equation of continuity is added as a constraint for the velocity field. Howard's conjecture that the maximizing solution of the Euler equations is characterized by a single horizontal wave number is shown to be true only for a limited range of the Rayleigh number Ra. A new class of solutions with multiple boundary layer structure is derived. The upper bound for the Nusselt number Nu given by these solutions is $Nu < (Ra/1035)^{1/2}$ in the limit when the Rayleigh number tends to infinity. The comparison of the maximizing solution with experimental results by Malkus and Deardorff and Willis emphasizes the similarity pointed out by Howard. Author

N69-20082 California Inst. of Tech., Pasadena.
ENERGY TRANSPORT BY COMBINED RADIATION AND CONDUCTION
Lon Edward Bell (Ph.D. Thesis) 1968 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 68-12727

The problem of one-dimensional radiative and conductive heat transfer in a medium bounded by two infinite parallel walls is treated. The medium isotropically absorbs, scatters, and emits radiation. The walls absorb and reflect isotropically, and transmit diffusely. Thermal conductivity, as well as all radiative properties, are assumed independent of temperature and wavelength. Steady state solutions are sought. Approximate solutions are developed for the temperature distribution and the heat transfer rate. The temperature distribution is expanded in a power series in a dimensionless variable that is a measure of the ratio of radiative to conductive energy transport. The first two terms are retained in the expansion. This allows the radiation integrals that appear in the basic equations to be expressed in a simple, readily evaluated form. Values for the heat transfer rate and temperature distribution are computed. Dissert. Abstr.

N69-20097 Michigan Univ., Ann Arbor.
INCIPIENT BOILING OF CRYOGENIC LIQUIDS
Kenneth James Coeling (Ph.D. Thesis) 1968 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 68-13295

The purpose of this work was to determine the heat flux and surface superheat necessary to initiate nucleate boiling, i.e., form the initial vapor, on a flat surface heating into a pool of saturated liquid hydrogen. Some incipient boiling data were also obtained with liquid nitrogen, used to check out the system. Natural convection and nucleate boiling heat transfer data were obtained with both liquids when the incipient boiling tests were conducted. The variables investigated are surface material, surface roughness, and orientations. The surface materials used are stainless steel, copper, Teflon, and a special surface consisting of a glass fiber web covered with epoxy cement. The stainless steel and copper surfaces were tested in both a polished and roughened condition. The orientations investigated are horizontal upwards, vertical, and horizontal downwards. Dissert. Abstr.

N69-20114 Purdue Univ., Lafayette, Ind.
RADIATIVE HEAT TRANSFER CHARACTERISTICS OF SPECIALLY PREPARED V-GRADE CAVITIES
William Z. Black (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-12523

Emission, absorption, and reflection characteristics of a V-groove cavity are analyzed and the resulting predictions are compared with experimental measurements. The configuration considered consists of a flat black base with diffusely emitting, specularly reflecting side surfaces. Local directional properties are given as a function of emission angle, position, side wall emissivity, and cavity geometry. These analytically determined properties are confirmed by measurements obtained from two different experimental systems. The results show that, with proper selection of the parameters, the cavity can be made a strong emitter and absorber for directions which are nearly normal to the cavity opening area, and a weak emitter and absorber for directions which correspond to large angles measured from the normal. Analytically predicted heat transfer rates for surfaces composed of many cavities are also presented. Experimental measurements of heat transfer rates for these surfaces are given and are shown to be significantly different from the rates obtained when diffuse surfaces are employed. The results of this investigation illustrate the potential value of using specially prepared grooved surfaces in applications where control of radiant energy exchange is desired. Dissert. Abstr.

N69-20127 Delaware Univ., Newark.
COMBUSTION CHARACTERISTICS OF CRYSTALLINE OXIDIZERS
Elmer Ellsworth Hackman, III (Ph.D. Thesis) 1967 124 p
Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 68-13157

A fundamental understanding of the combustion characteristics of crystalline oxidizers like ammonium perchlorate is important if complete knowledge pertaining to the combustion and stability characteristics of composite solid propellants is to be attained. This research involved theoretical and experimental studies of the burning of crystalline oxidizers ranging in physical form from large single crystals to low bulk density powders. Single crystals, visually perfect throughout most of their mass, were grown from saturated water solution by a temperature lowering technique using a bath-control system-data acquisition combination that maintained temperatures to ±0.001°C. Electrical conductivities and UV absorption measurements showed them to be of high purity. A strand-burner, window-bomb and high-speed cinematography were used to obtain burning rate versus pressure. Dissert. Abstr.

N69-20144 Ohio State Univ., Columbus.
THE USE OF ARTIFICIAL THERMODYNAMIC STATES TO PREDICT PROPERTIES OF HYDROCARBON GAS MIXTURES AT ZERO PRESSURE
William Sherman Cariens (Ph.D. Thesis) 1968 116 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-12823

It is shown that the thermodynamic states of the natural gas hydrocarbons can be defined with precision by only the three properties temperature, pressure, and molecular weight ratio. Such states are called artificial due to the approximations involved. The range of applicability for these artificial states is restricted to molecular-weight ratios between 0.554 and 0.70. Accurate tabulations for enthalpy and entropy calculations are presented for the mixtures in the ideal gas state. Furthermore, the perturbation of the mixture ideal gas states into the corresponding real gas states is discussed. The specific heats at zero pressure of the hydrocarbon portion of about 550 representative samples of natural gas mixtures were studied. These were based on the specific-heat data of the American Petroleum Institute Project 44. The temperatures ranged from 250° to 900°K. Dissert. Abstr.

N69-20219# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETONATION ATTENUATION IN LIQUID EXPLOSIVE MIXTURES OF TETRANITROMETHANE AND ETHYL IODIDE

V. S. Solovev et al Feb. 1968 12 p refs Transl. into ENGLISH from Fiz. Goreniya Vzryva (Novosibirsk, USSR), no. 3, 1966 p 31–35

(AD-681299; FTD-HT-23-141-68) Avail: CFSTI CSCL 19/4

A flame photographic study has been made of the detonation attenuation in liquid explosive mixtures of tetranitromethane and ethyl iodide which occurs on a sharp change in the direction of propagation of the detonation front. The charge was flat and of constant depth; only the channel width (unspecified) was varied. The tetranitromethane/ethyl iodide (oxidizer/fuel) volume ratio was varied from 27/73 to 30/70. Deviations from normal detonation development occurred only at component ratios below 30/70. The following experimental facts were observed: (1) detonation wave attenuation in the narrow channel prior to exit into the wide vessel (at component ratio 27/73); (2) detonation wave attenuation on exit from the narrow channel into the wide vessel (28/72); (3) detonation wave attenuation on exit from the narrow channel into the wide vessel, subsequent amplification and development of the detonation after reflection of the detonation wave from the upper edge of the vessel (29/71); (4) slight attenuation of the detonation from the sides on exit into the wide vessel and subsequent normal development of the detonation (30/70). TAB

N69-20287 Rensselaer Polytechnic Inst., Troy, N. Y.

THE DEVELOPMENT OF STEADY FLOW BEHIND A PLANE FLAME

John Henry Skinner, Jr. (Ph.D. Thesis) 1968 114 p

Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-13526

A theoretical and experimental study of the development of the flow field about a plane flame travelling at a constant velocity through an infinite tube is presented to determine whether there is any trend towards steadiness in the flow as observed in the flame-fixed coordinate system. The flow fields induced by a supersonic detonation and a subsonic heat source were analyzed by the method of characteristics for one dimensional nonsteady flow. Friction and heat transfer were accounted for, and the friction factor was related to the convective heat transfer coefficient through the Reynolds analogy. The characteristic equations were integrated numerically employing a high speed computer. For the supersonic flame, the initial flow field is non-steady in all frames of reference. As the detonation continues to travel at a constant velocity, the effects of friction and heat transver cause a region of flow to develop which is steady in a detonation-fixed coordinate system. This steady flow region begins directly behind the detonation and gradually grows to fill the entire flow field. Results of detonation experiments confirm the theoretically predicted development of steady flow. On the other hand, for the subsonic heat source, the induced flow is initially steady, but friction and heat transfer soon cause it to become nonsteady. As time progresses, the non-steady effects slowly decay and the flow field asymptotically approaches a steady state. Dissert. Abstr.

N69-20281*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

AN EXPERIMENTAL CORRELATION OF THE NONREACTIVE PROPERTIES OF INJECTION SCHEMES AND COMBUSTION EFFECTS IN A LIQUID-PROPELLANT ROCKET ENGINE. PART 5: ON THE INFLUENCE OF VANES ON COMBUSTION STABILITY

J. H. Rupe 15 Sep. 1967 31 p refs

(Contract NAS7-100)

(NASA-CR-100385; JPL-TR-32-255-PT-5) Avail: CFSTI CSCL 21 B

Experimental observations of a high amplitude resonant wave characteristic of several liquid propellant rocket engine configurations are presented. These observations led to the postulate that the disturbance is a detonation-like wave that is not dependent upon the acoustic properties of the cavity for either initiation or sustenance and a consequential conclusion that the nonlinear properties of such processes must be elucidated as a first step in controlling this combustion mode. Results of a cursory evaluation of the control introduced by baffles (or vanes) and the heat-transfer rates imposed on the chamber walls for the resonant mode as compared to steady combustion are included. Author

N69-20321 Wisconsin Univ., Madison.

THE EFFECT OF PERIODIC PRESSURE AND TEMPERATURE FLUCTUATIONS ON UNSTEADY HEAT TRANSFER IN A CLOSED SYSTEM

Daniel William Wendland (Ph.D. Thesis) 1968 356 p

Avail: Univ. Microfilms: HC $16.20/Microfilm $4.55 Order No. 68-9146

The purpose of this project was to study the nature of the unsteady heat transfer from a closed gas system to a plane metal surface with the gas experiencing periodic pressure and temperature oscillations. The gas system was defined by a piston-cylinder-head compression chamber; the piston was driven by a variable-speed motor to generate the gas pressure and temperature fluctuations. Gas pressure histories were measured with a pierceelectric pressure transducer. Gas temperatures were measured with a 3.81 micron hot-wire anemometer probe used as an uncompensated resistance thermometer. Instantaneous metal surface temperature was measured with a fast-response surface thermocouple with a one-micron junction thickness. A mathematical technique was developed to calculate instantaneous metal surface heat transfer rates: experimentally measured surface temperature histories were introduced into a digital computer program which calculated, listed, and plotted surface heat transfer histories. Dissert. Abstr.

N69-20332 Michigan Univ., Ann Arbor.

THERMAL STRESSES IN THICK-WALLED TUBES WITH LAMINAR CONVECTION HEAT TRANSFER

Daniel Paul Werner (Ph.D. Thesis) 1968 82 p

Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 68-13430

The purpose of this study is to obtain the axisymmetric thermoelastic stress distribution occurring in heat exchanger tubes under steady flow conditions. Review of the literature indicates that a solution is desirable which includes more realistic physics in the formulation of the problem that has previously been included. The thermal part of the problem is based on a modification of the classical Graetz problem in convection by including the heat capacity of the tube wall. Heat is assumed to be transferred to the ambient through an overall heat transfer coefficient which includes both the resistance of tube wall and the convective film coefficient to the ambient. The solution is obtained by use of separation of variables and Fourier series. Numerical procedures are used to extend the series solution to practical limits. In the entrance region an asymptotic representation of the temperature is found which is based on a modification of the Leveque model. The particular and complimentary stress solutions are given in terms of Goodier and Love–Galerkin displacement potentials, respectively. Numerical results illustrating the temperature gradient on the stresses is found to be small for distances greater than three outside radii from the entrance. Therefore, the plane strain solution may be used in this region. Experimental results are included. Dissert. Abstr.

N69-20337 Southern Methodist Univ., Dallas, Tex.
PARTICLE-TO-FLUID NUCLEATE BOILING HEAT TRANSFER IN A WATER FLUIDIZED MEDIUM
Fred Michael Young (Ph.D. Thesis) 1967 158 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-11845

An experimental study of nucleate boiling heat transfer from a water fluidized system of stainless steel balls was conducted. The steel balls were heated by a radio frequency induction heater to simulate processes involving internal heat generation in a fluidized medium. Regimes of particle, liquid, and vapor motion were defined and observed. The heat flux and saturation temperature difference could be correlated using the following modified form of Rohsenow's nucleate boiling equation. Cavitation observed as a result of flow through the fluidized medium is postulated to be the source of initial nucleation sites. As a result vigorous nucleate boiling was observed as low as 0.7°F saturation temperature excess. An empirical correlation of a system fluidized with a liquid or two-phase flow is given. Dissert. Abstr.

N69-20343# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TEMPERATURE FIELD IN A CRYSTAL HEATED BY RADIATION
V. V. Salomatov Apr. 1968 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk, USSR), v. 8, no. 5, 1965 p 86–89
(AD-681310; FTD-HT-23-15-68) Avail: CFSTI CSCL 20/2

An exact solution is presented for the problem of determining the temperature field in a crystal on whose surface heat exchange takes place by radiation and whose thermophysical characteristics depend on the temperature. Such a calculation is of importance for the growth and annealing of crystals, when it is desired to avoid surface and volume defects due to uneven temperature. The problem consists of solving the nonstationary heat-conduction equations subject to boundary conditions. The solution is by an integral-transformation method. Several particular cases are considered (constant initial temperature and constant radiant-heat source, linear variation or radiator temperature, exponential variation of the radiating medium). The equations obtained include the region of temperature below the Debye temperature. TAB

N69-20480# Picatinny Arsenal, Dover, N. J.
DETONATION
K. I. Shchelkin Dec. 1968 44 p refs Transl. into ENGLISH from Priroda (Moscow), v. 53, no. 7, 1964 p 14–23
(AD-680907; PA-TT-146) Avail: CFSTI CSCL 21/2

A brief definition of detonation is followed by a detailed discussion of how it occurs and how it can be made to occur in simple tubular apparatuses. Three basic types and detonation--weak, strong and Chapman-Jouguet--are described. The role of shock waves in causing detonations is discussed in some detail. The role of compression in the evaluation of shock waves is explained, and also the relation of shock waves to detonation. There are sections on Combustion in Rarefaction Waves, Pulsed and Spin Detonation, and discussions of how detonation occurs in explosive, in gasoline engines (and how certain additives are used to inhibit it there), and in coal mines. There is a final section on Nonstationary Double Explosions. Author (TAB)

N69-20481# Temple Univ., Philadelphia, Pa. Dept. of Physics.
CURRENT DISTRIBUTION FOR WIRE EXPLODED IN VACUUM
Do-Ching Chern and Theodore Konneff 31 May 1968 31 p refs
(Contract F19628-67-C-0250)
(AD-681120; AFCRL-68-0328; SR-1) Avail: CFSTI CSCL 19/1

This investigation explores the current sheath surrounding an exploding copper wire in vacuum. Rogovski coils are used to map the current sheath. The results are plotted as a function of time and radius. Soon after the transplosion of the wire, the current leaves the wire in an initially well-defined cylinder, which diffuses rapidly over time. Initial radial expansion is of the order of 100,000 cm/sec. A reverse current effect is also observed. Author (TAB)

N69-20681# National Bureau of Standards, Washington, D. C. Institute for Materials Research.
BIBLIOGRAPHY ON THE HIGH TEMPERATURE CHEMISTRY AND PHYSICS OF MATERIALS, OCTOBER–DECEMBER 1968
J. J. Diamond, ed. Jan. 1969 73 p refs
(NBS-315) Avail: SOD $0.70

A bibliography of high temperature physics for solids and liquids is presented. Lists are divided into the following groups: (1) devices for achieving temperatures above 1500°C; (2) devices for measuring and controlling temperatures above 1500°C; (3) devices for physical measurements at temperatures above 1000°C; (4) thermodynamic properties, at temperatures below 1000°C, of materials which melt above 1500°C; (5) properties, at temperatures above 1000°C, of materials which melt below 1500°C; (6) phase equilibria above 1000°C; reactions at temperatures above 1000°C. For gases, the bibliographies on spectroscopy of interest to high chemistry, and reaction between gases and condensed phases are included. F.O.S.

N69-20688# Joint Publications Research Service, Washington, D. C.
STUDIES ON AMMONIUM PERCHLORATE COMBUSTION—USSR
27 Feb. 1969 48 p refs Transl. into ENGLISH from Fiz. Goreniya Vzryva (Novosibirsk), v. 4, no. 3, 1968 p 299–333
(JPRS-47540) Avail: CFSTI

CONTENTS:

1. THE EFFECT OF ALUMINUM ON THE COMBUSTION OF AMMONIUM PERCHLORATE WITH POLYFORMALDEHYDE A. A. Zenin et al p 1–9 refs (See N69-20689 09-33)

2. KINETICS OF THE HIGH-TEMPERATURE THERMAL DECOMPOSITION OF AMMONIUM PERCHLORATE G. B. Manelis et al p 10–21 refs (See N69-20690 09-33)

3. CAUSES FOR ANOMALIES DURING COMBUSTION OF AMMONIUM PERCHLORATE AND NITRATE A. P. Glazkov p 22–23 refs (See N69-20691 09-33)

4. THE MECHANISM OF THE EFFECT OF V_2O_5 ON THE COMBUSTION RATE OF COMPOUNDS BASED ON AMMONIUM PERCHLORATE AND METALLIC FUELS L. D. Romodanova et al p 34–39 (See N69-20692 09-33)

N69-20689# Joint Publications Research Service, Washington, D. C.
THE EFFECT OF ALUMINUM ON THE COMBUSTION OF AMMONIUM PERCHLORATE WITH POLYFORMALDEHYDE
A. A. Zenin et al *In its* Studies on Ammonium Perchlorate Combust. 27 Feb. 1969 p 1–9 refs (See N69-20688 09-33) Avail: CFSTI

The effect of aluminum content and its dispersiveness was studied on a stoichiometric mixture using microcalorimeters. It was established that the surface temperature of the burning mixture increases with an increase in pressure, and does not change on

introducing aluminum. The temperature gradient in the gas phase on the surface and the thermal flux by thermal conductivity increase with pressure and combustion rate increases. The heat release in the condensed phase (c-phase) increases with pressure increase and drops on introducing aluminum. An explanation of these phenomena is proposed. The densities of the radiant fluxes from the flame of the burning mixture to the c-phase were measured. No more than 10 percent of the total heat was found to be introduced into the c-phase by thermal conductivity and radiation from the flame does not exceed 50 percent of the total heat introduced per gram of c-phase. Author

N69-20690# Joint Publications Research Service, Washington, D. C.

KINETICS OF THE HIGH TEMPERATURE THERMAL DECOMPOSITION OF AMMONIUM PERCHLORATE

G. B. Manelis et al *In its* Studies on Ammonium Perchlorate Combust. 27 Feb. 1969 p 10–21 refs (See N69-20688 09-33)
Avail: CFSTI

Investigations were made by the loss in weight and by the gas generation in the temperature range 320° to 453°C. It was demonstrated that the kinetic parameters of the reaction (O) are constant in a wide range of temperatures (200° to 450°C); however, above 300°C there is a decrease in the proportion of substance decomposing during the first, rapid stage of the reaction. The process of linear pyrolysis was experimentally studied. At temperatures below 500° to 550°C, flameless steady state decomposition took place. The kinetic constants determined from these experiments correspond to the data obtained under isothermal conditions. At temperatures above 500° to 550°C, the conditions of rapid gasification of the ammonium perchlorate accompanied by combustion of the pyrolysis products are realized. Author

N69-20691# Joint Publications Research Service, Washington, D. C.

CAUSES FOR ANOMALIES DURING COMBUSTION OF AMMONIUM PERCHLORATE AND NITRATE

A. P. Glazkov *In its* Studies on Ammonium Perchlorate Combust. 27 Feb. 1969 p 22–33 refs (See N69-20688 09-33)
Avail: CFSTI

Possible means of inhibiting chemical reactions during combustion of ammonium nitrate and perchlorate salts were investigated; it was found that one of them is inhibition of the water formed during combustion. The effects of additives on the combustion of ammonium perchlorate and ammonium nitrate catalyzed by chromium oxide were studied to explain the causes of combustion rate drops with pressure increases and the pulsating nature of the combustion. In a certain pressure range, the addition of silica eliminates the observed anomalies at the same time as the addition of calcium stearate increases them. Independently of pressure range and combustion conditions, the same additive can play the role of an inert additive, a catalyst, or a combustion inhibitor. The relation of this finding to the variation in the lead reactions in various pressure ranges is suggested. Author

N69-20692# Joint Publications Research Service, Washington, D. C.

THE MECHANISM OF THE EFFECT OF VANADIUM PENTOXIDE ON THE COMBUSTION RATE OF COMPOUNDS BASED ON AMMONIUM PERCHLORATE AND METALLIC FUELS

L. D. Romodanova et al *In its* Studies on Ammonium Perchlorate Combust. 27 Feb. 1969 p 34–39 6 p (See N69-20688 09-33)
Avail: CFSTI

The combustion rates of the compounds NH_4ClO_4 + Fe, NH_4ClO_4 + Zn, NH_4ClO_4 + Cd and the combustion rate of these compounds with a 1% addition of V_2O_5 were measured in the pressure range from 1 to 120 kg/cm^2. The experiments indicated that vanadium pentoxide increases the combustion rate by acting on the oxide film of metals for which the Pilling–Bedworth number α is little greater than one, but does not affect the oxide films of metals for which α appreciably exceeds one. The effect of vanadium pentoxide on metallic oxide films was found to be exhibited on the metal–oxide interface where the vanadates are formed. On decomposing they liberate vanadium pentoxide which again acts on the metal; the corresponding change in volume causes the formation of a porous film which is poorly bonded. In increasing the combustion of fuel compounds for which α is little greater than 1, very small quantities of vanadium pentoxide are sufficient, since regeneration occurs during the reaction. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N69-19843# Library of Congress, Washington, D. C. Aerospace Technology Div.

FOREIGN SCIENCE BULLETIN, VOLUME 5, NO. 2 A Monthly Review of Selected Foreign Scientific and Technical Literature

Feb. 1969 137 p refs
Avail: CFSTI

Papers are presented on the following topics: (1) a one year chamber test of life support systems using human subjects; (2) research on the biological effects of magnetic fields; (3) studies on the relationship between toxicity of elements and their electron configurations; (4) investigations of radiative transport cooling and its possible application to liquid rocket engines; (5) the historical development of the Soviet Central Aerohydrodynamics Institute; and (6) analysis of ball lightning phenomena and electromagnetic radiation as related to linear lightning discharges. Surveys conducted in satellite geodesy, photometric observations of satellites, and some applications of satellites in geophysical research, are reviewed, as well as research activities at the Machine Science Institute of the U.S.S.R. Academy of Sciences. Notes are also included on measurement of irregular components of radio signals from satellites and an open resonator wavemeter. Conferences held on the identification of underground nuclear explosions and organization of scientific and technical research are discussed. Several book reviews on various scientific subjects are also included. For individual titles, see N69-19844 through N69-19849. A.C.R.

N69-19851# Library of Congress, Washington, D. C. Aerospace Technology Div.

FOREIGN SCIENCE BULLETIN, VOLUME 5, NUMBER 1

Jan. 1969 117 p refs
Avail: Issuing Activity

Papers are presented on Soviet development of undersea vehicles during the past 45 years and a review of literature on stranes, a new class of physiologically active compounds. Recent developments in the area of physics, including manpower, facilities, research, specific topics, and administrative problems are described. A detailed treatment of a magnetometer used on the Lunik 10 and Venera 4 space probes for investigation of geomagnetic and

interplanetary magnetic fields is included. Also covered are conferences dealing with research on superconductive materials, physiochemical principles of developing new heat resistant inorganic materials, problems on engine strength, and sleeping difficulties during long space flights. Book reviews are included on various phases of gas dynamics, including effects of weak gravitational fields, computing methods, and shock wave phenomena. For individual titles, see N69-19852 through N69-19854. A.C.R.

N69-19852# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET-BLOC SUBMERSIBLE DEVELOPMENT
Lee Boylan *In its* Foreign Sci. Bull., Vol. 5, No. 1 Jan. 1969 p 1–55 refs (See N69-19851 09-34)
Avail: Issuing Activity

The first of three installments of a review dealing with the history, state of the art, and future development of submersibles in the Soviet Union and other East European countries is presented. Equipment designed or built between 1923 and the present is treated chronologically and tethered diving chambers, towed vehicles, and diver reconnaissance vehicles are included. Author

N69-19914# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
COORDINATION OF THE ACTIVITY IN THE FIELD OF ELECTRONICS AND OF INSTRUMENTATION. REPORT NO. 3: PHYSICS ELECTRONICS [COORDINAMENTO DELLE ATTIVITA NEL CAMPO DELL'ELETTRONICA E DELLA STRUMENTAZIONE. RAPPORTO N. 3 "ELETTRONICA FISICA"]
B. Rispoli 1967 149 p refs In ITALIAN and ENGLISH
(RT/EL(67)15) Avail: CFSTI

The four individual papers included cover the following topics: electric effects in the ionic bombardment of semiconductors, static and dynamic properties of a gadolinium–iron grain, the effect of superficial contamination on the emission of electrons from ions, and the construction of He^3-filled ionization chambers for detection of thermal neutrons. P.A.B.

N69-19981 Massachusetts Inst. of Tech., Cambridge. Electronics Lab.
[ELECTRONICS LABORATORY RESEARCH ACTIVITIES] Quarterly Progress Report for the Period Ending 31 May 1968
H. J. Zimmermann, G. G. Harvey, and S. J. Mason 15 Jul. 1968 279 p refs
(TID-24666; QPR-90) Avail: CFSTI

Electronic research activities reported pertain to general physics, plasma dynamics, and communication science and engineering. For individual titles, see N69-19982 through N69-20003

N69-20258# Army Materiel Command, Washington, D. C. Systems and Cost Analysis Div.
APPLICATION OF REGRESSION ANALYSIS TO HARDWARE COST ESTIMATION
John L. Hamilton and James T. Wormley Dec. 1968 27 p refs
(AD-681234; AMC-TR-68-10) Avail: CFSTI CSCL 21/5

The report presents an example of regression analysis which illustrates the major judgmental considerations in the development of a cost estimating relationship. The example used is the development of hardware costs of turbine aircraft engines. The methodology discussed is most useful for quick reaction studies and has been used by Headquarters, US Army Materiel Command for this purpose. Particular points discussed are: scatter diagrams, net scatter diagrams, causal requirements, combinations of variables, and sample selection. Author (TAB)

N69-20374# RAND Corp., Santa Monica, Calif.
PROJECTION OF SCIENTIFIC EVOLUTION AND TECHNICAL PROGRESS—ITS ROLE IN SOCIETY
Roger E. Lavien Nov. 1968 27 p Presented at the 6th Congr. of the European Comm. of the Intern. Council for Sci. Management on Projection of Sci. Evolution and Tech. Progr., Cannes, France, 25 Nov. 1968
(AD-680749; P-3995) Avail: CFSTI CSCL 5/2

The report discusses the past and present activities of a technical information center devoted to research and development on scientific problems. TAB

N69-20421 National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.
FACTORS CURRENTLY USED AT NPL TO PREDICT THE PERFORMANCE OF SINGLE-SCREW SHIPS ON MEASURED-MILE TRIALS
B. S. Bowden Dec. 1968 14 p
(NPL-SHIP-125) Avail: CFSTI

Present practice at the National Physical Laboratory for estimating the performance of single-screw ships on measured-mile trials are briefly described and the values of the prediction factors currently used are given. ESRO

N69-20473*# Strategic Air Command, Beale AFB, Calif.
CIVIL ENGINEERING ASPECTS OF GROOVING
A. R. Miller *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 313–323 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 13B

The grooving of runway and highway pavements has necessitated the Civil Engineering profession to develop methods and techniques to provide this requirement. The civil engineering aspects of runway grooving are primarily discussed. However, most of the factors discussed have equal application to the grooving of highway pavements. Significant items concerning design, preparation of plans and specifications, estimating, inspection of construction, and maintenance of grooving are considered. Data are based on experience gained as the result of grooving the portland cement concrete runway at Beale AFB with grooves 1/4 inch wide by 1/4 inch deep at 1 inch on centers. Beale AFB is a Strategic Air Command base located in a temperature climate approximately 50 miles north of Sacramento in California. Little or no freezing weather is encountered. The runway is extensively utilized by heavily loaded U.S. Air Force military aircraft including KC-135 tankers and B-52 bombers. Prior to design of the grooving project, tests were conducted by the National Aeronautics and Space Administration on the Langley landing-loads track. In addition, available information was gathered concerning grooving both at Kansas City Municipal Airport and John F. Kennedy International Airport. Author

N69-20476*# California State Div. of Highways, Sacramento.
PAVEMENT GROOVING ON HIGHWAYS
Eugene E. Farnsworth *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 411–424 refs (See N69-20451 09-11)
Avail: CFSTI CSCL 13B

Several years ago California Division of Highways accident analysis showed that some sections of concrete highways, especially on curves, were having an unusual number of accidents during rainy weather. Pavement grooving was applied to the surface of the

roadway in an attempt to reduce the number of wet pavement accidents. The project was financed by the U.S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads. Author

N69-20477*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

RESULTS FROM STUDIES OF HIGHWAY GROOVING AND TEXTURING AT NASA WALLOPS STATION

Walter B. Horne *In its* Pavement Grooving and Traction Studies 1969 p 425-464 refs (See N69-20451 09-11)

Avail: CFSTI CSCL 13B

Results of studies of the skid resistance obtained on 30 different pavement surfaces installed at the NASA Wallops Station airfield are discussed. Presented are transient peak, steady-state peak, and locked-wheel braking coefficients of friction for ASTM rib-tread and ASTM bald-tread tires and for new and worn production tires obtained under dry, wet, and flooded pavement conditions at vehicle speeds ranging from 10 to 80 mph. Results of limited vehicle spin-out tests on a 500-foot-radius highway curve are also included. It was found that the presently used method of making locked-wheel friction measurements to determine pavement skid resistance does not necessarily denote the true skid resistance of pavements under vehicle rolling or maneuvering conditions. Also, the skid resistance of smooth closed-texture pavements tends to be dangerously low under wet conditions when vehicles are operated at high speed with worn tires. However, the more open textured pavements as well as the transverse and longitudinal groove pavements exhibited adequate skid resistance for the vehicle speed and tire conditions investigated. Author

N69-20478*# Clipper Mfg. Co., Kansas City, Mo.

RESULTS FROM STUDIES OF HIGHWAY GROOVING AND TEXTURING BY SEVERAL STATE HIGHWAY DEPARTMENTS

Larry G. Mosher *In* NASA, Washington Pavement Grooving and Traction Studies 1969 p 465-504 refs (See N69-20451 09-11)

Avail: CFSTI CSCL 13B

In an effort to combat the increasing rate of automobile accidents, several State highway departments have been evaluating the pavement grooving process to increase the safety of their highways. The process and results of pavement grooving being performed at several locations are discussed herein. At locations where accident data are available, this technique appears to be very effective in the prevention of wet-weather accidents; however, for most of the locations, accident data are not available. Author

N69-20487# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.

AN INDUSTRIAL DYNAMICS STUDY OF THE FACILITIES PLANNING PROCESS

Luis Teodoro Gutierrez Nov. 1967 166 p refs

(Contract DAHC04-68-C-00002; Proj. Themis)

(AD-680934; THEMIS-UF-TR-2; AROD-T-1.15-RT) Avail: CFSTI CSCL 5/1

This is a study on the dynamics of the facilities planning process and its influence on the potential growth of the organization. The investigation is carried out by means of an industrial dynamics simulation model. IBMs CSMP (Continuous System Modeling Program) is used as the simulation language. The results of the investigation indicate that, all other things being equal, the performance of the facilities planning function is critical in determining the actual growth pattern of the organization. It is further concluded that the industrial dynamics formulation of the facilities planning problem should prove to be a valuable planning tool to the practicing industrial engineer. Author (TAB)

N69-20614# Centro Nazionale di Fisica dell'Atmosfera e Meteorologia, Rome (Italy).

PROGRESS REPORT ON CENFAM ACTIVITY FROM 1 OCTOBER 1966 TO 30 SEPTEMBER 1967 AND ON RESEARCH PROGRAM FOR 1968 AND COST ESTIMATES [RELAZIONE SINTETICA SULL'ATTIVITA DEL CENFAM DAL 1 OTTOBRE 1966 AL 30 SETTEMBRE 1967 E SUL PROGRAMMA DI ATTIVITA NEL 1968 CON RELATIVO DI PREVENTIVO DI SPESE]

M. Giorgi Consiglio Nazl. delle Ric. Sep. 1967 32 p In ITALIAN Submitted for publication

(CENFAM-RDP-18) Avail: CFSTI

The Centro Nazionale di Fisica dell'Atmosfera e Meteorologia is organized in five research groups and five special research programs. The Center's activity during 1966-1967 is illustrated and their reports and papers are listed. For the year 1968 a program has been prepared and costs have been estimated. ESRO

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